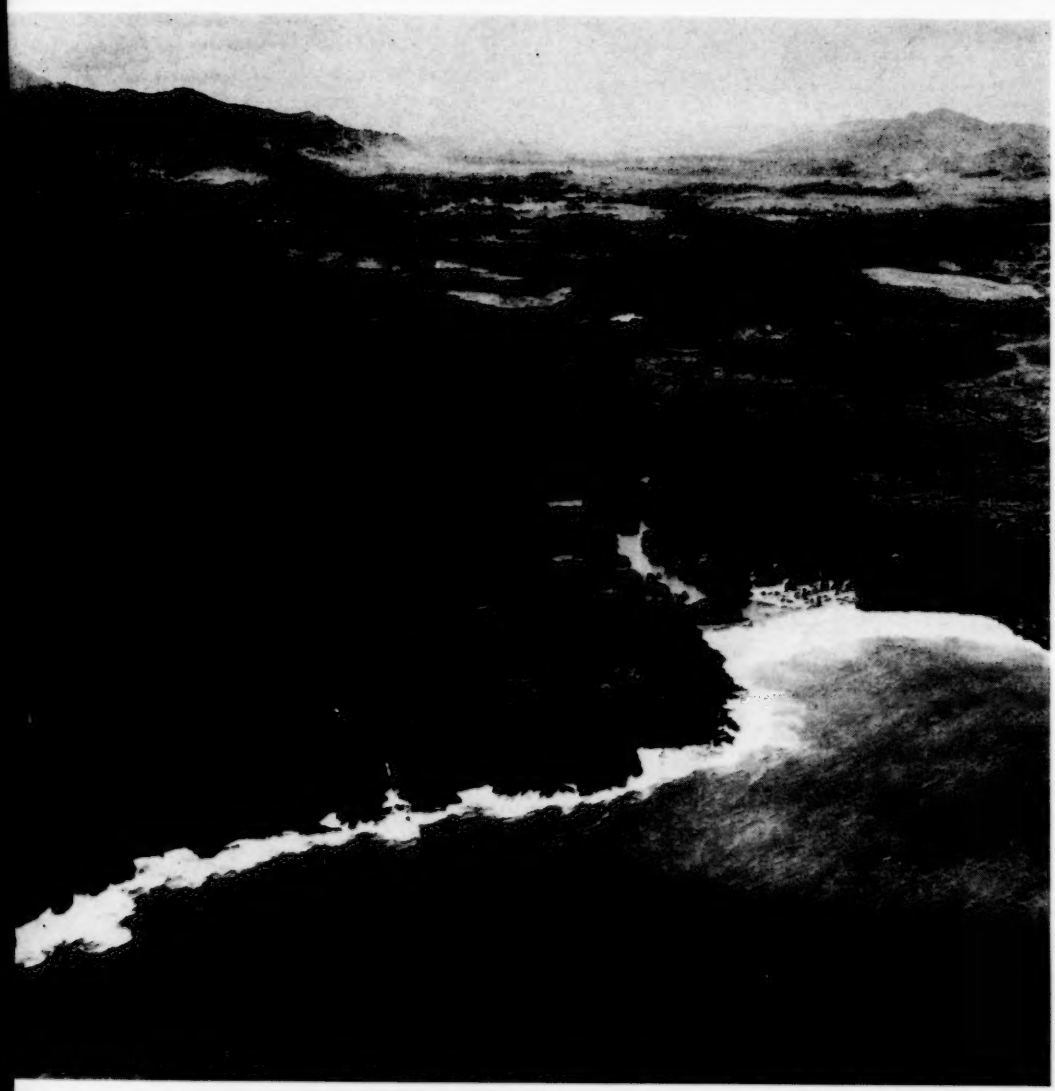

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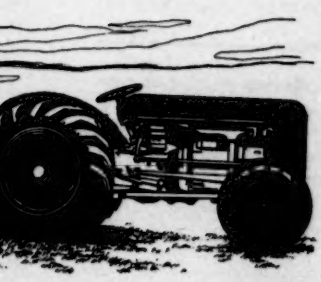

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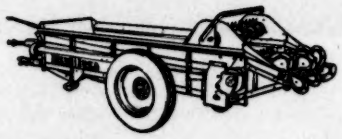

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Linear Programming: A New Tool for Watershed Planning

GEORGE A. PAVELIS AND JOHN F. TIMMONS

SINCE PASSAGE of the Watershed Protection and Flood Prevention Act in 1954 (Public Law 566), the upstream watershed has become the focus of coordinated soil and water management. As many writers have already noted, the community watershed approach to resources development links conservation farm planning with programs for major improvements along main stems of rivers. This should permit objective and comprehensive solutions to the nation's varied and perplexing soil conservation, water-use, and water-control problems.

Despite the promising outlook for adequate tributary development, several important problems pervade the agronomic, engineering, and economic phases of small watershed planning. First, multipurpose concepts heretofore identified with river basins must be applied in evaluating development proposals for much smaller areas. Second, the dependence of program success on local-federal cooperation requires that planners come to grips with the difficult job of reconciling economic objectives of farmers who control watershed uplands with those of downstream private or public interests affected by upland use. A third problem is the formulation of programs for accomplishing the related economic objectives of maximizing social net returns over time from the use of watershed land resources (achieving an optimal level of conservation), and then allocating development costs equitably among project beneficiaries.

The general purpose of this review is to report briefly how these planning problems were treated in a research study completed recently in the Nepper Watershed, located in western Iowa. The 480-acre Nepper Watershed is only one of many tributaries to the Maple, Little Sioux and Missouri Rivers, but represents quite well the complexities of planning watershed protection programs for upstream areas. The study was initiated in 1954 by the Iowa Agricultural and Home Economics Experiment Station, with the University Departments of Agricultural Engineering, Agronomy, and Economics jointly participating.

Early phases of interdisciplinary research in the Nepper Watershed emphasized the development of techniques for evaluating such watershed-damage problems as gullying and flooding. Subsequent research was concerned with the planning process itself, a problem conceptually involving (a) seven farm operating units, the local county, and the downstream area along the Maple River as a community of watershed interests; (b) predevelopment

George A. Pavelis is Agricultural Economist, Farm Economics Research Division, Agricultural Research Service, U. S. Department of Agriculture; and John F. Timmons is Professor of Economics, Iowa State University. *Material presented herein is the result of efforts of an interdisciplinary watershed research group, also including Agronomists W. D. Shrader and Orvis Engelstad and Agricultural Engineers R. K. Frevert and Howard P. Johnson. Economists John A. Nordin and Norman Landgren of the University staff provided useful suggestions for the preparation of this article, as did several co-workers in the Farm Economics Research Division.*

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deviation from a maximum of social net returns from agricultural production, a maximum which cooperative watershed development might achieve; (c) a range of land treatment and structural measures effective in achieving maximum returns; and (d) the complex of land, labor, and capital resources available for development purposes.

Research Techniques

In following through the planning process from the analysis of development problems to the formulation of optimal watershed programs, interests of all participants were integrated and reconciled in the previously developed (1) concept of a "watershed firm." A watershed firm can be considered very usefully as an abstract decision-making agent making planning decisions on the basis of both watershed and off-site benefits and costs, with due regard that no farmer or public entity be damaged and uncompensated by programs representing optima for all participants as a group. The watershed-firm idea is raised from an abstraction to reality in the creation of formal organizations representing all local interests and able to comply with conditions for cooperation of off-site participants in the form of technical and financial assistance. However, organizational aspects of watershed development are not discussed in this paper, mainly to direct attention to problems involved in formulating rather than implementing optimal programs. Reference is made to other studies emphasizing institutional arrangements (2) (3).

Two techniques of economic appraisal were utilized in planning optimal development programs for the Nepper Watershed. The first of these was conventional benefit-cost analysis. It was required to eliminate the feasible agronomic or engineering measures that would fail to provide any net benefits—or—would require a greater outlay than competing measures providing the same gross benefits. The second technique was "linear programming," a mathematical device now used widely in farm management to budget out and compare a large number of alternative farm enterprises or production plans. Linear programming applied to watershed planning is essentially a tool for program formulation, in that land or structural treatments with benefit-cost ratios exceeding 1:1 are combined with reference to available resources to maximize aggregate net benefits. This review is concerned with presenting results of using the two techniques rather than with their theoretical aspects. Discussions of the particular relation of benefit-cost criteria to watershed planning and the application of linear programming to farm management are published elsewhere (1) (4).

The Nepper Watershed Planning Program

The benchmark situation from which benefits and costs of each land treatment and structural measure were computed was selected as that pattern of land use and consequent damages prevailing in the Nepper Watershed in 1947. The year 1947 rather than a more recent date was taken as the base simply to facilitate formulation of optimal programs without reference to a going program partially installed in 1948.

A summary of 1947 land use and correlated damage problems in the Nepper Watershed is presented as the first column of data in Table 1, while the first section of Table 2 indicates corresponding returns and costs for the seven on-site farmers, Monona County as the on-site public interest, and the downstream area along the Maple River as an off-site public interest. All annual returns and costs (including damages) were computed with reference to a 50-year (1947-97) economic horizon, with private values discounted at 5 per cent and public values at 2½ per cent.

Benefits and costs of each land treatment measure were then estimated as the changes in returns and costs induced by shifting land use on each of 27 cropland fields from the system prevailing in 1947, the benchmark year. Benefits of increased productivity, for example, were estimated as the projected values of increases in yields of corn, oats, or hay obtained by adopting new rotations, practicing contour tillage, applying commercial fertilizer, or building terraces. Gully-control benefits were computed as the amount by which average annual gully damage in the form of destroyed land values could be reduced by the same cropping or conservation practices. Flood-control benefits were taken as further amounts by which annual flood damage to on-site crops, a county bridge, and the downstream area could be reduced by shifts in land use and conservation measures.

TABLE 1

Comparison of Land Use and Resultant Damages Under Predevelopment Resource Use and Optimal Development Programs in the Nepper Watershed

Compared Items	Predevelopment	Development Programs[1] A	B	C
Land use items		*Per cent by items*[2]		
Cropland in corn	53	51	64	63
Cropland in oats	19	19	12	10
Cropland in meadow	28	30	24	27
Terraceable cropland terraced	0	0	74	98
Additional cropland contoured	0	0	8	11
Cropland fertilized	0	1	50	83
Correlated average annual damages	*Dollars*	*Per cent reduction*		
Gully damage, all on-site	137	1	33	43
Flood damage, on-site bridge	385	8	56	70
Flood damage, on-site crops	2,803	5	100	100
Flood damage, off-site	140	0	47	55

[1] Development programs A, B, and C are successively based on optimal cost allocations of $9.60, $3,706, and $5,716 in obtaining maximum net benefits. Costs and benefits are summarized and distributed among participants in Table 2.

[2] Land use percentages are based on a total watershed area of 480 areas, a cropland area of 311 areas, and an additional contourable cropland area of 35 acres.

TABLE 2

Distribution of Predevelopment Returns and Costs, and Development Benefits and Costs Among Program Participants in the Nepper Watershed

Return and Cost Items	On-site Farmers	Monona County	Off-site Public	Watershed Total
	(dollars)	(dollars)	(dollars)	(dollars)
Predevelopment (1947) Resource-use Situation				
Total returns	19,750	0	0	19,750
Total costs	11,657	385	140	12,182
Net returns	8,093	-385	-140	7,568
Development Program A—Critical Treatment				
Total benefits	259.64	30.91	0	290.55
Total costs	8.93	0.67	0	9.60
Net benefits	250.71	30.24	0	280.95
Net benefit-cost ratio	29.26	29.26	0	29.26
Development Program B—Intermediate Treatment				
Total benefits	11,656	215	66	11,937
Total costs	3,618	67	21	3,706
Net benefits	8,038	148	45	8,231
Net benefit-cost ratio	2.22	2.22	2.22	2.22
Development Program C—Complete Treatment				
Total benefits	15,034	273	77	15,384
Total costs	5,585	102	29	5,716
Net benefits	9,449	171	48	9,668
Net benefit-cost ratio	1.69	1.69	1.69	1.69

Costs of land treatment included any additional farm expense of obtaining increased yields, plus annual charges associated with the installation or maintenance of terraces or permanent pasture. These costs were allocated among beneficiaries in proportion to discounted values of

total credited benefits, a procedure which assumed that costs would be shared willingly on a basis permitting equal but favorable benefit-cost ratios for all beneficiaries. The number of land treatment measures found to have favorable benefit-cost ratios came to 47.

Four structural improvements (or groups in cases of interdependence) were analyzed as alternatives to land use changes for controlling runoff associated with evaluated gully and flood damage. All were appraised by estimating benefits and costs per unit of size, which was proportional to capacity. Units for a levee system were feet of bank height and for all other structural measures were earth-fill volumes in cubic yards. The benefit-cost analysis indicated that one facility would yield less in benefits than it would cost per unit to fill. Consequently, it was eliminated as a development activity allowed to compete for development resources with the 3 remaining structures and 47 land treatment measures. As with land treatment, the costs of each structural measure were allocated among beneficiaries in proportion to any gully and/or flood-control benefits likely received.

Principal restrictions on combining the 47 land treatment and 3 structural measures in development programs for the Nepper Watershed related to land, maximum structure capacities imposed by engineering considerations, and capital. Surveys had indicated that additional labor needed for some land treatment measures or particular fields would not have exceeded labor being unused.

Because it was recognized that an essential of complete development plans would be specification of the land use changes suggested for particular areas within farms, the cropland area of the Nepper Watershed was divided into 27 farm fields for purposes of the benefit-cost analysis reviewed above. The field areas represented 27 land-resource subclasses for which unique inputs and outputs characterizing various treatment measures were determined. Therefore, each field area was a land restriction, in that net program benefits would be limited eventually by each field being treated to yield maximum net benefits per acre.

Limits on structure size specified that one grouped facility could not exceed 40,850 cubic yards of earthfill; fill in another could not exceed 14,400 cubic yards; and that the heights of levee banks could not exceed 6 feet. The limits approximated capacities required for complete elimination of gully and flood damage, independently of reductions credited to treatment of uplands as sources of such damages.

A final restriction on development measures and programs was represented by the present value in 1947 of all investment and recurring outlays necessary to initiate and continue land use changes, or to install and maintain structures over the planning horizon 1947-97. These amounts were computed as annual equivalents of capitalized cost. Considering each of the 27 field areas, the 3 structure size limitations, and capital in the sense of capitalized cost, a total of 31 restrictions were imposed on planning the Nepper Watershed.

Given the possibilities for obtaining development benefits and the limitations on taking full advantage of these possibilities, the program-formulation problem to be solved by linear programming the Nepper Watershed thus reduced to the following question: Considering the 31 resource or technological restrictions stated above, how should the 47 land treatment and 3 structural measures found to promise net benefits have been undertaken in 1947 and maintain over the period 1947-97 to maximize discounted net benefits for the watershed as a whole?

Programming Essentials

Because there would be little merit in detailing the complete mathematical solution to the Nepper Watershed planning problem, results will be preceded only by some basic concepts underlying a linear-programming approach to the types of resource-allocation questions posed by watershed planning generally.

Suppose that benefit-cost analysis of a number of land treatment measures physically feasible for a 6-acre watershed field revealed that only two treatment measures would promise more in identifiable discounted benefits than they would involve in discounted (capitalized) cost. The two measures thus isolated can be designated as P_1 and P_2, measured in acres.

Next assume that P_1 undertaken over the entire 6-acre field would involve an equivalent annual cost of $130, would gross $541 in identifiable on-site and off-site benefits, and would thus net $411, or $3.16 per unit of cost. Then assume that measure P_2 undertaken over the entire field would involve an equivalent annual cost of $62, would gross $382 in total identifiable benefits, and would thus net $320, or $5.16 per unit of cost. Inspection of these data shows that P_2, while evidencing a higher benefit-cost ratio (or rate of return to capital), would be preferred alone only if the amount that would be spent were limited to $62 or less, because P_1 in yielding $411 in net benefits obviously would represent a more profitable use of the 6 acres if costs were of no concern.

Figure 1 takes the same data and shows how such economic problems involving differential returns to capital and land resources can be solved by applying programming principles. If costs were of no concern in maximizing net benefits from treating the 6-acre field, any combination of the two treatments bounded under the 6-acre land-supply line AB would be feasible from a resource-availability standpoint. Clockwise, the arrows

denote proportional combinations of no treatment by P_1, equal P_1 and P_2, P_1 twice P_2, and no P_2. Lines labeled with specified costs represent iso-cost contours and those with specified net benefits represent iso-benefit contours, much like a topographical map if elevation could be measured in dollars instead of feet.

Returning to the sample problem, if land use were not limited by scarce funds, \$130 could be spent in treating the entire field by treatment P_1 and net benefits would be maximized at \$411, the "highest" net benefit contour touching (at point A) both the land-supply line AB and the specified \$130 cost contour.

On the other hand, if funds were limited to \$62, the entire 6-acre field would be treated by treatment P_2 rather than P_1, and net benefits would be maximized at \$320, the highest benefit contour touching (at point B) both the land-supply line AB and the specified \$62 cost contour.

If available funds ranged between \$62 and \$130, the problem of maximizing net benefits is not as simple, but logic says that some combination of the two treatments would maximize net benefits. If available funds happened to be \$107, for example, the line segments BC and DC would trace out the benefit possibilities. Maximum net benefits obtained from an expenditure of \$107 without treating more than 6 acres would be about \$381, denoted by the benefit contour just touching BCD at point C. The arrow going through point C is labeled $P_2 = P_1/2$. Because the entire 6-acre field could be treated, this means that 4 acres would be given treatment P_1 and 2 acres given treatment P_2.

Figure 1 admittedly deals with an optimal allocation of resources between only two competing treatments for only a single watershed field. But solution of the complete Nepper Watershed problem involving 50 land or structural treatment measures and 31 resource restrictions applied the same principles to allocate resources optimally among all measures both within and among all fields, and hence, within and among farms or throughout the watershed. Additionally, alternative optimal programs were derived that would maximize watershed net benefits for any amount of expenditure that might be specified as available for development purposes, using a special refinement of linear programming credited to Candler (5).

Results of Programming the Watershed

Results of using linear programming to formulate optimal development programs for the Nepper Watershed are given as follows for only three general project types:

Program A was a project of very limited scope because of assumed severe limitations on funds. Such a hypothetical project for the Nepper Watershed with 1947 as the planning date included a single land treatment measure critical in providing net development benefits; the measure of criticality for each treatment was the magnitude of its benefit-cost ratio. Data for the measure with the highest benefit-cost ratio—29.26—are given in column 2 of Table 1 and section 2 of Table 2. This single-measure "program" involved a change in 1947 land use on a steep field from continuous corn and no conservation practices to permanent meadow. Evaluation of pre-development conditions had indicated that this field was a primary source-area of both gully damage and all types of flood damage. Off-site benefits of the change to permanent meadow were so negligible, however, that off-site entries for program A in Tables 1 and 2 are zero.

Program B was a project of a somewhat expanded scope as greater but still limited funds were allocated optimally. Column 3 of Table 1 indicates the resulting land use distribution for the watershed as well as percentage reductions in various classes of gully or flood damages. Corresponding benefit-cost data for program B are presented in section 3 of Table 2.

Program C. With no limit on program expenditure, any measure that adds more to program benefits than to program costs can be undertaken and net benefits will be maximized thereby. Section 4 of Table 2 shows that such a program installed in the Nepper Watershed would have produced total annual benefits of \$15,384 for a comparable outlay of \$5,716, and thus netted a maximum of \$9,668 in benefits distributed among the seven watershed farmers, Monona County, and the off-site area. An annual outlay of \$5,716 represented a maximum justifi-

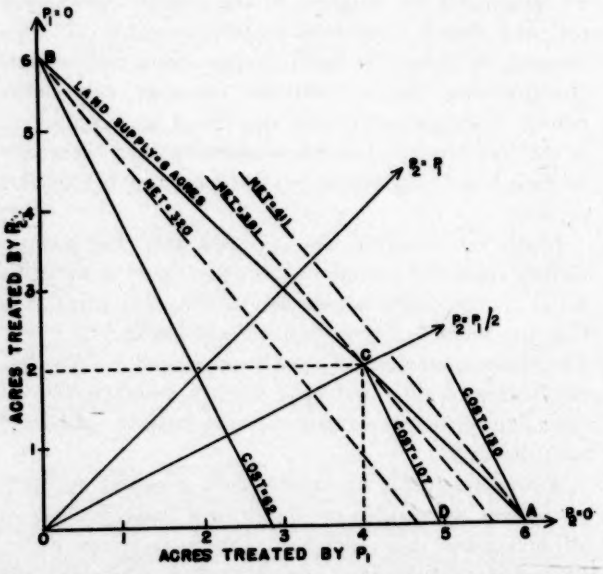

Figure 1. Programming optimal combination of land treatment.

able expenditure on watershed treatments because a greater outlay would have reduced aggregate net benefits to below $9,668.

Under the land use pattern resulting from program C, as shown by column 4 of Table 1, the watershed area annually in corn would be increased to 63 per cent from the 53 per cent without a program; that in oats would be decreased to 10 per cent from the predevelopment percentage of 19; and the proportionate area in meadow would remain almost unchanged at about 27 per cent. The increase in the acreage of corn, however, would require that level terraces be installed on nearly 98 per cent of the terraceable watershed area. About 11 per cent more of the watershed cropland would need to be contoured, and 83 per cent would need applications of commercial fertilizer. The land-treatment measures would reduce sheet erosion to below a 5-ton per acre annual rate on all watershed cropland, would reduce gully damage by 43 per cent, flood damage to the county bridge by 70 per cent, and off-site flood damage by 55 per cent. Flood damage to on-site crops would be completely eliminated under either program B or C, by land treatment measures in conjunction with a levee system as the only structural measure required to maximize average annual net benefits.

Guidelines for Future Planning

The major conclusion drawn from the study reported here is that linear programming warrants trial by planning technicians as a supplement to their benefit-cost evaluations of watershed treatment measures. It can help avoid the formulation of projects yielding anything less than maximum benefits for any given outlay. The advantages of mathematical programming in this respect and its consistence with economic theory are shown in Figure 2. The horizontal axis of the figure measures total program costs. The upper vertical axis measures total and net benefits plotted against costs. Average and marginal (incremental) benefit-cost ratios are read on the lower vertical scale. Program A, which suggested and permitted only the conversion to permanent pasture of a single field representing a major source-area of watershed damage, practically coincides with the vertical axis of Figure 2 by involving only $9.60 in annual cost (see also Table 2).

As outlays greater than $9.60 were considered in the Nepper research, it was financially possible to consider measures with benefit-cost ratios lower than the 29.26 ratio for program A. For program B as shown in the upper section of Figure 2, for example, an outlay of $3,706 allocated most economically would produce total benefits of $11,937 and net benefits of $8,231; the same data are given in section 3 of Table 2. The corresponding over-all or average net benefit-cost ratio amounted to 2.22 and the incremental or marginal ratio (for the last measure added) to 1.46, as shown in the lower section of Figure 2.

In the special case of planning with unlimited funds as in program C, any measure with a net benefit-cost ratio greater than zero (or a gross ratio greater than 1:1) would increase net benefits. For program C, as shown in Figure 2 and Table 2, annual gross benefits are $15,384, total costs are $5,716, and net benefits amount to $9,668. Its average benefit-cost ratio is 1.69 (for included activities) and the marginal ratio (for any additional activities) zero.

Figure 2 also indicates that, although the average and marginal benefit-cost ratios for program C were well below those for programs A and B, its net benefits were considerably greater. This implies that the object of project formulation by linear programming or any other means is not to maximize benefit-cost ratios as such, but to maximize them with respect to a given outlay or cost. The latter approach assures a maximum of net benefits because it involves the addition or substitution of measures in descending order of their marginal net returns, with the extent of addition or substitution limited by the specified expenditure being allocated.

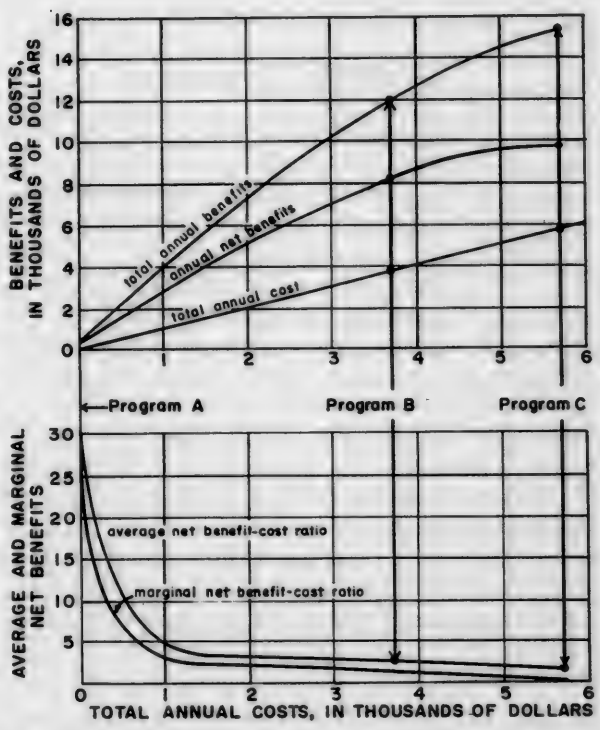

Figure 2. Optimal development programs for the Nepper Watershed.

Figure 3. An inadequate drainage ditch allowing upland runoff to frequently overflow the Nepper Watershed floodplain under predevelopment conditions prior to 1948.

Figure 4. A 6-foot levee being constructed in 1948 to replace the inadequate ditch. Floodwaters shown would thereafter be diverted into the Maple River.

Figure 5. Soil profiles exposed by a gully destroying 1/7 of an acre per year under predevelopment conditions prior to 1948.

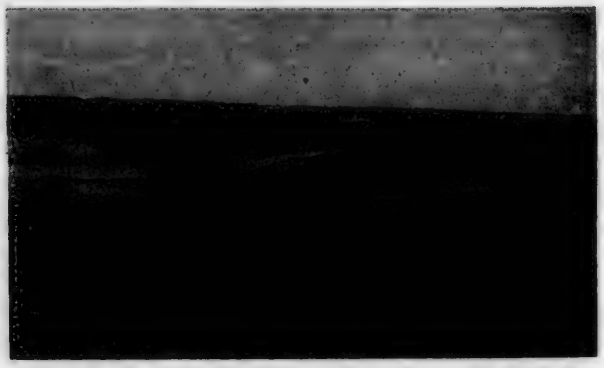

Figure 6. A drop inlet in process of construction in 1948 to control the same gully and also provide some flood-plain protection. (Soil Conservation Service photos.)

Concluding Comments

The approach to planning taken in the Nepper Watershed research study is most relevant to those field situations in which any measure proposed is accepted only as a provisional alternative, and a number of alternatives are evaluated for each watershed sub-area or structure site. The fact that a measure shows a favorable watershed ratio of benefits to cost merely promises a net gain to the watershed as a whole from its installation, and not even necessarily a maximum net gain for the cost involved. Moreover, without adequate compensation arrangements it could result in significant losses to some project participants and off-project areas. Research in the Nepper Watershed showed that watershed planning can proceed on a basis whereby measures are combined in such a way as to render aggregate net benefits a maximum, but subject to stated restrictions imposed by available resources, cost-sharing requirements, and the welfare condition that projects not leave anyone damaged and uncompensated.

Linear programming as a tool for formulating watershed projects derives its utility chiefly from being a systematic method for evaluating simultaneously the relative contribution of a large number of measures toward project objectives, and then checking any selected combination of measures against a number of restrictions on achieving the objectives, a number that might also be large. The fact that many of the basic functional relations between land use, watershed hydrology, and resultant benefits or costs may not be of a linear or straight-line nature does recommend against indiscriminate use of the method, but many of these difficulties can be overcome by special adaptations.

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Aloha Hawaii

—Some Water and Soil Conservation Aspects in the Island Paradise

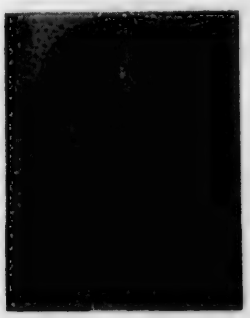
J. H. CHRIST

ALTHOUGH EXPLORING EXPEDITIONS, principally the Spanish, had been sailing in Pacific waters since the early 1500's it was not until 1778 that Captain James Cook, an English voyager, actuallly discovered and placed the location of the larger islands of the Hawaiian group.

The archipelago extends some 1,400 statute miles northwest and about 200 miles southeast of Honolulu. Except for Hawaii, Maui, Oahu, Kauai, Molokai, Lanai, Niihau, and Kahoolawe, the others that make this extended island pattern are largely shoal banks, reefs, pinnacles, and small islands. All except Midway Island are part of the state of Hawaii.

Present day travelers between the islands of the Hawaiian chain obtain an expressive picture of the land. Nowhere is it seen so vividly as by the air route which is almost the sole means of inter-island passenger transportation. Wooded mountain slopes, deep lush tropical valleys, and rain forests all emphasize the intent of nature to clothe the land with protective measures. Man's green fields and windbreaks show up vividly on agricultural lands.

The population density of the island of Oahu is approximately 640 persons per square mile or one per acre, which is greater than either the United Kingdom or Japan, and is just under that of Puerto Rico. When one visualizes the large land mass unsuitable for homes or farms, competition for land can be appreciated. Competition is further intensified by the ownership pattern which is characterized by a few owners of large parcels of land and many owners or lessees of small 1 to 10-acre tracts of land. Even though the population of the outer islands is much less, competition for land is almost as keen as on Oahu. It appears that statehood has only 'boomed' the boom. The increasing local population, more Mainland businesses becoming identified operationally in the new state and an exceedingly rapid expansion of tourist interest, add still further pressures to the limited land area.



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Agricultural Lands

A total of 1,415,684 acres, or 30.4 per cent of the land was retained in Territorial ownership in 1956. Responsibility for the administration of the largest amount of this acreage was with the President of the Board of Agriculture and Forestry and the Commissioner of Public Lands. Land under leases and licenses with the latter officer was about 437,000 acres.

Twelve private land owners each having over 30,000 acres control 30.09 per cent of the land in Hawaii. The largest of these ownerships is the Trustees, Bernice Pauahi Bishop Estate with 370,171 acres (8.99 per cent).

Of the 5,750 farms reported in Hawaii in the 1950 Census, some 3,558 are less than 10 acres in size. There was a total of 3,558 enterprises as follows: vegetables, 311; fruit and nuts, 78; coffee, 394; sugarcane, 160; dairy, 16; poultry, 303; livestock other than dairy, 331; general, 137; miscellaneous and unclassified, 1,828.

Many of the small farms are in urban or suburban areas. They produce nursery stock, flowers, and vegetables. On Oahu the small farmer is gradually being pushed out by urban expansion either to the more remote areas or to the steeper marginal land. It is difficult for a person wishing to farm to either lease or buy land. Land suitable for development is limited and costs of improving it are high. The state government seeks to open public lands to settlement where there is evidence to show that the area is suitable for farming or stock raising.

Most small farms are on Hawaii. There is a heavy concentration of coffee farms at Kona, and a large number of producers of poultry, vegetables and fruit, and hogs. Next largest concentration is on Oahu which leads in the number of vegetable and hog producers. This island also has a large part of the chicken and fruit producers. Sections at Koko Head, Waimanalo, Waianae, and Pearl Harbor have a large number of small farms. Maui has many producers of poultry, vegetables, and hogs. The Olinda-Kula section on this island is largely small farms. Kauai has the fewest small farms.

Soil Conservation Districts

Organization of Soil Conservation Districts in Hawaii is virtually completed. Sixteen districts have been organ-

ized since enactment of authorizing legislation in 1947. SCD's include 3,474,632 acres comprising 4,410 farms.

Directors and cooperators of Hawaii's districts can be real proud of the good conservation work they are carrying out on farms and ranches. Ranchers, farmers, sugar and pineapple plantation managers and assisting Soil Conservation Service technicians all have had a hand in applying soil and water practices and getting more and more conservation on the land.

Conservation problems here cover a wide range of conditions, many of them within narrow ranges of climatic and elevational limits. The public is giving good support to the program aimed at protecting and improving Hawaii's land and water resources.

Hydrologic Problems Are Complex

Water management problems, for example, are complex, to say the least. Geologic, hydrologic, economic, and social factors are so interwoven that it is difficult to search and find the key.

Geology of this new state is so recent that the latest addition to the island of Hawaii by volcanic action was recorded in 1955. The porous volcanic islands are literally sponges in the sea. In some areas mountains rise vertically from the sea 2,000 to 3,000 feet. There are areas of limited coastal plains which slope quickly to the steep mountains, and also plateaus between the volcanic mountain ranges, and all within a very short distance. Mauna Loa and Mauna Kea on the big island of Hawaii rise over 13,000 feet above the sea and slope steeply to the coasts.

Hydrologic conditions in the islands are as elsewhere, the products of climate, geology and plant cover. Prevailing northeasterly trade winds bear warm moist air from the sea to the islands. Air is forced upward by the mountains and is cooled as it rises. Rain is precipitated as air cools, then as dewatered air moves down the leeward side of the mountain it again becomes warm and picks up moisture with a dehydrating effect. Windward coastal areas may have an annual rainfall of 20 inches which increases to 100, 200, 300, and even 400 inches in the mountains in a distance of 6 or 7 miles. Rainfall on the leeward side of the mountains decreases progressively down the slopes, with some leeward coastal areas receiving less than 10 inches average annual rainfall. There are few perennial streams and most of the rain is absorbed by the porous mountains.

Occasionally, especially during the winter months, certain pressure patterns cause the winds to shift to the southwest, and "Kona" storms which reverse the trade winds cause great volumes of rain to fall in the normally dry areas. Infiltration rates of mountains are exceeded, and the result is a disastrous flood along the populated coastal plain.

Figure 1. Windward Oahu, an area of dairies, banana and papaya plantings and truck farms, but now subject to the pressures of an expanding population. Some of Honolulu's workers and business people are moving to subdivisions created in this rural setting. (Soil Conservation Service photos.)

Figure 2. Representatives of the sponsoring agencies for the Waianae Area Watershed Project from the West Oahu Soil Conservation District and the City and County of Honolulu meet with Soil Conservation Service officials to study and discuss activities contemplated in the watershed. Most streams here discharge directly into the ocean.

Figure 3. Governor William F. Quinn presents Mr. Seiso Otani of the Olinda-Kula Soil Conservation District with the certificate designating him Hawaii's "Conservation Farmer of the Year."

Gross water supply of Hawaii is precipitation on the various islands of the state. Rain which falls in the mountains either infiltrates through the porous lava formation and moves downward, is trapped by impervious dikes of dense lava in the mountains, or escapes as surface runoff. Water which moves downward becomes part of a huge lens-shaped body of fresh water floating on the

Figure 4. Torrential rains deal out damage to unprotected fields. Here is a sample of the work of hurricane "Dot" on August 6, 1959.

Figure 5. Torrents of storm water cause excessive damage to channels with limited capacity and destroy structures.

sea water. This is Hawaii's ground water. Water trapped in the mountains is the source of water for water supply tunnels bored horizonally into the mountains to tap these natural high-level reservoirs. This is a common, but very expensive means of development, and yields cannot always be predicted.

Very few sites in the state are suitable for the construction of impounding reservoirs because of the permeable rock formations, the steep and narrow-sided valleys and the problems of reservoir fillage due to rocks and debris washed down the steeply-inclined stream beds.

Various locations in the state which have adequate rainfall have utilized "water proofed" catchment areas for contributing runoff to storage tanks.

Storm damage is costly. Take, for example, the flood that hit Oahu, November 28-29, 1954. The storm damaged some 31,040 acres. This added up to 6,950 acre-inches of lost soil or 940,000 tons.

Accelerated Erosion Problems

Accelerated erosion in Hawaii dates back to advent of herds of domestic animals into the Islands. Natives had hogs, dogs, and chickens at the time of discovery of the Islands in 1778 by Captain James Cook. On this voyage of Cook's, goats were introduced. Cattle and sheep were left on visits by Captain George Vancouver in 1793 and 1794. A kapu or ban placed on the slaughter of the animals, which was maintained for upwards of 30 years, permitted a rapid increase of livestock. This caused major changes in an area that had developed without indigenous hoofed animals in the biota.

The heavy koa forest that originally clothed the steep lands failed to reproduce itself because young trees had been grazed. Trampling exposed the roots of older trees and they started to die out. Reports as early as 1840 speak of concentrations of herds and decrease of pro-

Figure 6. Silting basins recover soil carried to sugar mill in present machine harvesting methods. The desilted water is returned to the irrigation system, the soil to the fields.

Figure 7. An excellent papaya planting on a crushed aa lithosol. Mulching and windbreaks are recommended conservation practices in such areas.

Figure 8. Providing channels to dispose of storm runoff waters, as shown in this masonry channel, are needed in Kona, Hawaii's premium coffee growing district.

Figure 9. Diversion ditches in sloping sugar cane fields effectively reduce runoff and provide for silt deposition near place of origin.

tective grasses. To fight heel flies, flocks of sheep created stamping grounds on windy knolls. This resulted in barren eroded hills and soil slips. As livestock increased, outwash slopes became denuded and alluvial flats became dusty plains.

The most visible areas of erosion damage are on rangeland. Gullied slopes and spreading areas of rock outcrops show the losses that have taken place. In heavy storms, silt from these areas is carried into the ocean, often discoloring it several miles from shore.

In spite of the amount of eroded lands, little sugarcane acreage has been abandoned from that cause. Plantations that have ceased operations have done so largely because of climatic and economic conditions rather than soil losses. This does not mean that erosion is not a threat to the cane lands. The soil mantle on the steeper slopes in higher rainfall belts is gradually being thinned. Present field harvesting methods bring large quantities of soil to the mills with the cane. This, too, is a direct loss from the fields.

Some soil is saved, particularly at mills having hydroseparators or other settling devices. Other mills desilt the wash water in settling basins to develop new cane lands. The clarified water can be re-used in the mill or returned to the irrigation system and soil can be returned to fields. At other plantations the silty water and mill wastes are flumed to the ocean.

Truck and fruit growers also experience serious soil losses on unprotected land in heavy storms.

The steepness of cultivated slopes has an important bearing on erosion. Cane is found on Kauai on slopes of 35 to 40 per cent, on Hawaii on slopes of 50 to 60 and even 70 per cent. Pineapples can be seen on 30 to 40 per cent slopes and truck farms in sections of Maui on slopes as steep as 40 per cent.

Preliminary information from Hawaii's conservation needs inventory provides expressive data on land conditions in this new state. The land area shown in the following table is exclusive of federal lands, military reservations, national parks, other lands, and urban lands. "Other lands" is defined as farmsteads and idle land, wildlife areas, and other areas not classified in the categories listed.

DISTRIBUTION OF LAND BY CAPABILITY CLASSES, HAWAII

Class	Acres	Total Land Per Cent	Per Cent Farmed	Per Cent Pasture	Per Cent Watershed	Per Cent Other
I	20,940	0.6	84.0	6.4	9.0	
II	120,380	3.4	84.0	11.4	3.2	1.4
III	221,100	6.2	35.6	24.5	36.2	3.7
IV	279,300	7.8	29.0	27.5	40.7	2.8
I-IV	642,220	18.0	43.4	22.8	31.1	2.7
V	820	0.02	0	100	0	0
VI	726,270	20.3	4.7	31.3	56.0	8.0
VII	1,723,920	48.3	0.07	15.5	77.0	7.43
V-VII	2,451,010	68.7	1.4	20.2	70.8	7.6
VIII	473,380	13.3	0	0.9	9.4	89.7
All Land	3,566,610	100	8.8	18.1	55.5	17.6

The urgency for carrying out effective conservation measures is strikingly shown when only 18 per cent of the land available is in classes I to IV. As elsewhere in the United States, the acreage of Class I land is small indeed. Hawaii shows but six-tenths of one per cent in this category.

From these calculations, it appears that there is a substantial acreage of land in classes I to IV which can be developed for cropland in preference to less desirable and more hazardous land in classes VI and VII.

Since practically all of Hawaii's lumber is shipped in, it shows that with 55.5 per cent of the total acreage in a woodland status, there is an abundant opportunity to bring commercial timber plantings into the economy of

Figure 10. A 25-year plantation of swamp mahogany, Eucalyptus robusta. Thousands of acres, now producing trees or shrubs considered to be of little value, could be converted to the production of commercial timber species.

Figure 11. Ranch operations are geared to 12-months' grazing per year. Low coastal areas such as shown here are frequently used for the finishing pastures.

Hawaii. A timber resource survey being conducted by the U. S. Forest Service is expected to be completed in 1963.

Sugar cane is the chief money crop of the Islands and occupies most of the cultivated area. Slopes range from almost level coastal lands to those of 70 per cent slope in higher elevations. Irrigation is a necessity in lee sections of the Islands having less than 55 inches of well-distributed rainfall. Some soils are very shallow, underlain with coral. Others are deep, friable and highly permeable. Depending on location, cane matures for harvest in 18 months. Elsewhere it may take cane 42 months to mature.

These are some of the many and varied conditions found in producing a single crop. Landowners and conservationists run into varied conditions, too, in growing other crops such as pineapples, coffee, papayas, macadamia nuts, mangoes, many truck crops, grasses, legumes and trees that are adapted to this tropical area.

Progress Made in Soil and Water

Design and application of conservation practices has progressed steadily from the first assignment of a Soil Conservation Service technical staff in the Islands in 1938. This staff was redeployed in the war years, 1942-1945, and a completely new start was made in 1946. After passage of the Hawaii Soil Conservation District Act in 1947 and the subsequent organization of Soil Conservation Districts, personnel was assigned to meet the increasing work load.

Practices were designed to meet conditions found in the Islands. Research data, farmer experience, and judgment were drawn upon to formulate guides for doing the work. But with the exceedingly varied conditions found in Hawaii, there were few practices that could be standardized to extensive land areas. Extreme differences in soils, climate, elevation, and land use require adapting practices to narrow belts for good planning.

Field tests and trials and evaluation studies are undertaken to supplement other data or to seek out clues for more formal investigation. These field activities are developed in collaboration with the Hawaii Agricultural Experiment Station and Extension Service. Aspects of the work included in these categories are: irrigation evaluation studies, infiltration tests, seeding trials, fertilizer tests, forage trials, economic studies of production, soil survey investigations, diversion ditch evaluations, study of small drainage run-off data to determine criteria for spillway and structural design, determination of consumptive-use of water by crops, studies of sealing reservoirs, and study of the effectiveness of various cover crops.

This requires comprehensive investigation in broader phases involving (1) *basic soil problems* and availability of plant nutrients, soil structure, and soil-water relationship; (2) *water management,* irrigation requirements by kinds of crops, effectiveness of sprinklers, efficiency of present systems, and costs of developing supplemental water supplies; (3) *soil management,* improvement of soil fertility for forage production, management of fine-textured soils, treatment of saline and alkaline soils, use of mulches and cover crops, the climatic influence on crop adaptation; and (4) *plant management,* pasture establishment in various climatic zones, development of seed resources of desirable grasses and legumes, and brush and weed control.

Along with research there is a need for determining responses of crops to fertilizer treatments and adaptation and use of plants under farm and ranch conditions.

Malihini Can See . . .

A newcomer to this brand new island state, a "malihini" to Hawaiians, finds more new and interesting features in farming here than in any similar size area of the United States.

Damage from torrential, high-intensity rains can be effectively curbed where sugar plantations use diversion ditches, protected channel outlets, and strip cropping in fields.

Papaya orchards often are hard hit by winds. Ninety per cent of a full-bearing orchard may be destroyed by gusty winds that occasionally strike the islands. When orchards are protected by dense windbreaks of native ohia, damage is light.

One large planting of acerola cherry, a high vitamin C crop, in the Puna SCD has an 11-mile, three-row, shelter-belt planting of paper bark, *Melaleuca leucadendron*, a tree on the order of eucalyptus.

Cover crops are working out well in macadamia nut, coffee, papaya and mango orchards. Crotalaria, Spanish clover and a big trefoil are among the legumes used for this purpose. Cover crops of oats and vetch, a common Mainland combination, is equally effective here in protecting truck crop land during the critical rainy period of December to February.

Mulches are also proving effective on open truck crop or other open fields. Mulches are made up of bagasse, the fiber from sugar mills after the sweet juices are removed; chopped up Napier or other heavy-stemmed grasses; parchment from coffee berries; and sawdust and woodchips. All are used when available to the farmer.

Mulching helps reduce erosion, conserves moisture, makes better use of fertilizers and keeps weeds down. Truck crop farmers say mulching helps them carry their crop production over a longer period than on non-mulched fields.

Key management practices with the Hawaiian livestock operator involve fenced paddocks, adequate water, growth minerals, and fertilization of improved forage.

Rotation grazing finds a special usefulness in capitalizing on a 12-month grazing season in this tropical climate. This favorable situation calls for more conservation work such as eliminating woody invaders in pastures, keeping out undesirable weeds, and shifting livestock to areas where animals gain on strong forage in contract to losing weight on washy feed.

Rainfall Belts Pose Special Understanding

Buffel and bluepanic grasses grow in the driest 10 to 20-inch rainfall areas; Guinea grass and koa haole, Leucaena glauca, a shrubby legume, in the 20 to 40-inch areas; kikuyu, Bermuda grasses and kaimi clover, a Desmodium, in the 40 to 60-inch belts; and in the 60-inch plus areas pangola and Dallis grasses and big trefoil show excellent adaptation. Each of these plant-use groups have special seasons of use and a definite regrowth period for favorable production.

Picking and managing the right kind of plant for each rainfall belt calls for broad knowledge and strict attention to needs of both plants and animals to keep pastures highly productive.

Although parts of Hawaii are credited with world records in rainfall—624 inches in a 12 month period in 1948 on Waialeale on Kauai Island, other areas require irrigation almost the year-round. We're seeing more sprinkler systems on farms and ranches in SCD's on Molokai, Kauai and Oahu. Gated pipe is being used effectively to make good use of water supplies.

Redesigning irrigation systems likewise provides for more effective use of water in contrast to old outmoded, wasteful, high labor cost distribution systems. Many Hawaii soils are very permeable, so much so they are totally unfit for reservoirs. Sealing materials such as asphalt panels, plastic films, or sprayed on asphalts are proving very useful in making good use of limited and valuable water supplies.

Irrigation water is needed for a large part of cultivated acreage in Hawaii. Proportionately less cropland is irrigated on the Island of Hawaii than elsewhere. Areas benefitting from irrigation on the Big Island are in North Kona, North and South Kohala, and Hamakua sections.

The upper valleys on all the islands generally have adequate rainfall for truck, fruit crops, and flowers.

Pineapple companies have found that small amounts of water added during May, June, July and August, or in periods of extended drought as in 1952-53, produce a more uniform crop with less fluctuation of yield.

Of 117,418 acres of irrigated land reported in the 1950 Census, 112,237 acres were on 43 farms (plantations) of 260 acres or more. Total number of farms reporting irrigated acreage was 1,158. Of these 765 were under 10 acres.

In the past, irrigation water for cane has been applied by surface methods. Presently, new-type sprinkler irrigation equipment has been introduced experimentally on several sugar plantations.

Water for pineapples is distributed by portable sprinkler systems, by sprinklers from tank trucks, or from tractor-mounted sprinkler booms fed by flexible pipe.

Sprinkler irrigation is gaining in popularity with truck, fruit and flower producers.

Irrigated pastures provide year-round production and smooth out seasonal fluctuations in production.

Some Agricultural Economics

In 1958, agricultural income totaled $275,576,000, which was $22 million less than in 1957. A costly sugar strike caused a $41 million decrease in the value of the sugar crop. In addition, horticultural specialities were estimated at about $1,500,000. The total sum included, sugar, $105 million; pineapple, $124 million; livestock, over $31 million; and diversified crops and livestock products $46½ million.

Good advances are being made in exporting some of Hawaii's specialty products such as: fresh papaya, fresh

pineapple, papaya nectar, canned papaya slices, guava nectar, passion-fruit nectar, macadamia nut, and green coffee.

These and other crops, now being tested, could be expanded substantially. The limiting factor is not production of the crop per se, but the cost of keeping it within a competitive range, consumer acceptance, overcoming shipping problems, or continental U. S. A. mainland quarantine restrictions on the raw or rooted product.

Rice, cotton, sisal, tobacco and a number of other staple crop plants have been grown successfully in Hawaii. They failed, however, to attain a competitive position because of higher production costs.

Crops being tested that appear to have promise are: Koa haole as a substitute for high-protein supplements being imported, litchi, ti, cherimoyas and other fruits of the family Annonaceae, vanilla, sandalwood, lauhula products, taro, bananas, longan, mangosteen, mango, avocado, cacao, citrus, acerola and pepper.

Practically all the livestock of the independent producer is marketed on consignment. The two largest beef-slaughtering companies are on Oahu. The producer delivers his cattle to the meat company. They may be held for a limited period in feed lots for fattening, on grass pasture or killed immediately. The carcass is held in cold storage until it is turned over to a buyer. Then returns are made to the cattle grower.

Beef is delivered to the retailer as quickly as it can be taken up by the trade. When there is a lag in consumer demand or where the retailers are heavily loaded with Mainland shipments, Island beef is retained as carcasses in storage or on the hoof. When this happens the normal delivery pattern for market-ready livestock is disrupted.

Some of the larger ranches have their own slaughter houses. Here they can kill for local delivery or ship dressed carcasses to the larger Honolulu market. In this case most of the market beef follows the consignment route.

Hogs are marketed somewhat differently than cattle. Separate companies handle slaughtering. There are no storage facilities of consequence at the killing plants and the carcass is sold almost as soon as chilled. If there is a glut in the market, hogs may be held on farms until the trade can take the pork. Sales are made by the producer or a producer's organization to the wholesaler or retailer. Slaughtering is on a charge per head basis. The wholesaler acquires the offal of the carcasses he buys. Distribution is by wholesalers to the retail outlet, not by the slaughtering companies to the retailer as with cattle. A cooperative organization of hog producers is active in pack production circles on Oahu.

A little more than half the Island's beef comes from local sources. Until the last decade it was no problem for the Island producer to dispose of his animals. The grass-fed Island cattle was accepted by the consumer. More recently, people of Hawaii followed the trend of the Mainland consumer. They responded to the advertising campaign of the meat industry and asked for increasing quantities of well-finished feed-lot beef. This has caused the Hawaiian cattlemen to study ways of improving their product, thereby putting it on a competitive level with imported meat.

Feed mixtures using high proportions of local by-products are being studied. Combinations of molasses, fish meal, pineapple bran, and bagasse with urea show promise in producing higher grades of meat. Feed lots have been set up for fattening animals.

There were 13,230 head of mature dairy cows in the Islands in 1958. Some 2,086 head of dairy cattle were imported in 1958.

Average amount of milk produced per cow per day was 11.2 quarts. Total milk marketed from local production was 52,481,000 quarts. Heavy importations of butter, butterfat, cheese and canned and dried milk are made to supply consumers' needs.

As Honolulu's metropolitan area continues to expand, some of the larger dairies are moving their operations. Some dairy leaders predict that in time the bulk of Oahu's milk supply will come from other islands.

The agricultural economy of the Islands hinges on sugar and pineapples—the prime users of labor, materials and shipping. They provide the trade balance between exports and imports. Both are subject to stiff competition. Sugar-beet competes with producers on the Mainland and pineapples with all other canned fruit and juice products.

Hawaii's sugar production is the highest in the world. In 1956 average production was 5.14 tons of raw sugar per acre on a 12-month basis. The highest 12-month record for yield per acre as 1955 with 5.37 tons. A record crop was made in 1955 by the Olokele Sugar Company of Kauai. It manufactured 7.76 tons of raw sugar per acre on a 12-month basis. By comparison, averages for 1954 for Hawaii and other sugar producing sections were Hawaii, 5.01 tons; Australia, 3.7 tons; Florida, 3.43 tons; Puerto Rico, 3.28 tons; Philippines, 2.0 tons; Cuba, 2.0 tons; and Louisiana, 1.94 tons per acre.

Sugar production quotas apply to both preferred nations and domestic producers. Hawaii produces about 1,100,000 tons of sugar. This is almost one-fourth of all the sugar produced in the United States, and about 3 per cent of world sugar production.

Sugarcane in 1958 occupied 70.8 per cent of the cultivated land and pineapples 23.9 per cent. Combined total acreage of land used for these two crops is almost 95 per cent of Hawaii's cultivated acres. The area produc-

ing vegetables, fruit, nuts, coffee, and other produce is 5.3 per cent of cultivated land. Returns from the sugarcane acreage were 148 million dollars in 1956 and from the pineapple acreage the same year, 117 million dollars. With such a large part of cultivated land in sugarcane and pineapples, plantation operations have a major influence on soil and water conservation.

Mechanization and Land-Use Changes

Since 1946 revolutionary changes have been made in plantation operations. Prior to 1946 labor was plentiful, relatively cheap, and cane was harvested by hand. Cane tops and other residues were left on the land and provided an effective mulch for open fields.

As plantation labor came under union organization, field operations were rapidly mechanized to offset increasing labor costs. Bulldozers with shear blades were used to cut and windrow the cane after it had been defoliated by burning. Cranes with double-jawed cane grabs were used for loading the cut cane. Field railroad systems have almost entirely given way to trucks for hauling the cane to the mills. Soil-protective features of the hand-harvested cane were largely lost.

These changes created complex soil-management problems which did not exist under the old system. Heavy trucks and machinery compact the soil, thus seriously affecting moisture penetration and water storage.

The former effectiveness of the ratoon crop in controlling erosion is lessened under the new sysem. Cutting with machines frequently leaves only a partial stand of cane and requires replanting of uprooted areas.

Soil losses are greatest on non-irrigated plantations. These are in higher rainfall belts and usually slopes are considerably steeper. High-intensity storms cause tragic soil losses on open fields. Where the cane canopy is closed, there is little soil movement except on field roadways.

Hawaiian cane in the past was usually irrigated by the "closed" system. Ditches made a herring-bone pattern with "feeder" or head ditches on two sides of the field. There were no pickup ditches.

Although the system of growing cane under irrigation offers protective features, torrential rains even of short duration can break the ditch systems and cause severe washing. A peak period in the storm of November 28, 1954, caused a severe breakage of furrows on an Oahu plantation. The intensity reached 3.5 inches per hour. A contributing factor to the furrow failure was an earlier, prolonged, rainy period which saturated the soil.

Within the last few years, "long line" systems are being installed using aluminum flumes. This is an adaptation of the conventional furrow system. It provides for increasing the head of water at intervals on the feeder lines.

Figure 12. Hawaiian method of harvesting pineapples by use of conveyor belt and loading directly to truck for transport to cannery.

Figure 13. Almost an operation of the past—hand harvesting sugar cane. Note the protective mulch of the stripped cane.

Figure 14. Present harvesting methods by use of a push rake result in bare fields following harvest. Contrast with Fig. 13.

Figure 15. Loading and hauling sugar cane from fields. The use of such heavy equipment causes problems of soil compaction.

The pineapple pack in 1955-56 of 18,464,061 cases of fruit was the largest on record. The pack of pineapple juice was highest in 1954-55 with 13,011,268 cases. Fresh frozen chunks and fresh frozen juice concentrate are also on the market.

Hawaii, in 1957, produced 58 per cent of the world's canned pineapple and 76 per cent of the world's pineapple juice. Here, most of the pineapple companies are both growers and packers. Estimates of market demand are forecast several years in advance of planting a new crop.

Pineapple products enter into a highly competitive market. In 1956 the pack of pineapples was 18.5 million cases. Canned fruits of all kinds in the United States were 128.6 million cases. The juice pack for the same year was 12.1 million cases out of a total U. S. pack of 119.7 million cases. The percentage of pineapples in the canned fruit trade has decreased and pineapple juice lines have not maintained the percentage increases shown by such competitive leaders as frozen orange concentrate and tomato juice.

The change to labor-saving equipment came about on pineapple plantations at the same time as on sugarcane lands. Pineapples usually occupy land where the water supply is not adequate for the production of cane. Pineapple culture has come through several stages. Formerly little attention was given to field layout and rows and roadways ran up and down hill. Wash from fields was so heavy that there was considerable abandonment of the upper steeper slopes.

As awareness of erosion increased, operators turned to field systems that offered better possibilities of control. Several plantations designed and installed effective terrace systems on all their land. Others terraced only more critical areas. At any rate, extensive progress was being made in adopting erosion-control systems when the labor situation became acute.

With mechanization, layout of fields was generally redesigned to conform to the lay of the land. Fields are rather uniformly either 100 or 130 feet wide, permitting use of equipment having 50 or 65 foot booms. Spraying for insects and plant diseases, fertilizing, irrigating, and harvesting are done with various adaptations of boom equipment. Although terrace systems do not conform to redesigned field layouts, they are generally being maintained.

Mulching equipment has been designed and is being improved to keep pineapple stumps on the surface. Formerly these residues were plowed under or burned. Repeated diskings and natural disintegration gradually reduced the material until fields could be replanted in 9 months or a year. Thus, two crops could be grown in 4 years. Now is is possible, through the use of residues as a surface mulch, and other improved cultural methods, to obtain two harvests in 3 years.

Figure 16. The fresh pineapple passes along these lines of workers in the canning process at Hawaiian Pineapple Company's plant in Honolulu, one of the largest in the world.

The mulch practice is not entirely satisfactory in all respects, however. At higher elevations the sweetness of the fruit is reduced and ripening is delayed when a mulch is used. Also, in higher rainfall areas root rot is a constant threat on either mulched or unmulched fields.

Burning to reduce residues is often used to reduce the time between harvests. Only finer parts of the plant are destroyed; heavier parts then are turned under.

In pineapple fields a plant residue mulch covers only half of field area. Propagating pieces are planted through a layer of tarred or asphaltic paper. The mulch effectively takes up runoff from the covered strips.

Extensive studies are being made to determine the adaptation of potentially exportable crops. Expanding the production of truck crops for local consumption is not the answer for enlarging the Island's agricultural economy. It is estimated that about 600 acres of adaptable land would fill the needs of vegetables imported from the Mainland, excepting potatoes and onions. For these, about 1,900 acres would be needed and for citrus fruit 1,200 acres. The local price of produce is influenced by delivered costs of imported products. It provides a favorable price level for local producers, but also restricts the outlet for Island produce. Local distributors, buying on the Mainland, invest in imported produce, while much of home-grown vegetables are sold on a commission basis. This situation, a "pocket market", restricts production to the consumptive ceiling of the Islands, less the Mainland importations.

There's much more conservation work to do, but there is a firm, real desire by many Hawaiians to see that the lands of this Island Paradise continue to deserve the title. It is good to see the progress made in agriculture in the last half century and to note the way many fine people are working to make Hawaii's agricultural lands more stable and productive. ■

Changes in Land Use in Michigan Soil Conservation Districts

EARL E. FENTON

TECHNICAL ASSISTANCE in conservation farm planning is provided to Soil Conservation Districts, at their request, by the Soil Conservation Service of the United States Department of Agriculture. Since July, 1937, farmers in Michigan Soil Conservation Districts have availed themselves of planning facilities by making application to the directors of the districts. In working with an individual landowner in developing a soil and water conservation program for his land, and in planning for establishing appropriate conservation practices, the technician and the farmer are guided by the following:

- An inventory of the lands involved which indicates soil type, per cent of slope, degree of erosion, and capability of the land, as well as other pertinent information on land conditions.
- Results of research indicating the effectiveness of the various conservation programs and practices in controlling erosion, preventing soil deterioration and in improving soil conditions.
- Type of farming enterprise in which the farmer is interested.
- Financial and managerial ability and desires of the farmer to carry out various alternative conservation programs.

Considering these factors the technician and the farmer work together to develop a plan for the farm. The decision of the farmer as to the type of land use program he intends to follow is recorded and becomes the basis for an agreement between him and the district.

Purpose and Method of the Study

In 1952, Soil Conservation Service technicians were assisting farmers in 67 Michigan soil conservation districts to plan soil and water conservation programs. At that time about one Michigan farmer in 16 had developed a conservation farm plan in cooperation with his soil conservation district. With such a program in operation and available to a majority of Michigan farmers it appeared timely to evaluate the changes in land use that would be effected by the acceptance and establishment of conservation programs on a much larger percentage of Michigan farm lands. A study, for this purpose, was authorized to be started early in 1952.

The source of data for the study was a randomly selected sample of conservation farm plans from each soil conservation district where a sufficient number of plans had been developed to permit the selection of a sample adequately reflecting the local trends in conservation planning. (Data from 53 soil conservation districts covering 16,889,370 acres of the state were included in the study.) Samples of plans were obtained from the individual local problem areas in each district in sufficient numbers to represent an acreage equivalent to 3 per cent of each area.[1]

The study was directed only at an evaluation of land use changes that would be effected by the complete establishment of conservation planning on the lands of the districts. It was not designed to include information on planned acreage changes for individual crops, changes in soil management practices that were provided in the conservation plans, nor information on anticipated changes in yields. Further, no attempt was made to determine the actual extent to which the planned programs of the sample plans had been applied on the land.[2]

From the sample plans data were tabulated on the land use pattern existing at the time the conservation farm plans were developed, and on the land use pattern that would be achieved through the carrying out of the conservation plans.

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[1]Problem area refers to a land unit within a soil conservation district where the associated soil, drainage, slope, erosion, and soil conservation problems are essentially the same.

The procedures utilized in the collection of basic data were developed by John S. McVickar, Head, Department of Agriculture, Western Illinois State College, Macomb, Illinois; formerly research assistant, Department of Resource Development, Michigan State University. For a more detailed description of the sampling procedure see John S. McVickar. *The Problem Area as a Basis for Developing a Soil Erosion Map*, JOUR. OF SOIL AND WATER CONS., Vol. 9, No. 6, November 1954. McVickar was assisted in the collection and tabulation of data by Lewis E. Arnold, formerly research assistant, Department of Resource Development, Michigan State University.

[2]An independent study of this type has been reported on by C. R. Hoglund, *Soil Conservation in Michigan, Progress and Problems*, Michigan Agr. Expt. Sta., Special Bul. 39, 1955.

Obtaining the Data

Specific data were obtained for the two periods on each of the following eight land use categories:

1. *Row crops*—a crop planted in rows, usually 2 to 4 feet apart, to allow cultivation between the rows during the growing season. This includes all inter-tilled crops except those described as truck garden crops. In Michigan, the most common are corn, field beans, soybeans, sugar beets and potatoes.

2. *Small grains*—grains which are either sown, broadcast or drilled in close rows so that they cannot be intertilled. In Michigan, the most common are wheat, oats, rye, barley and buckwheat.

3. *Rotation hay and pasture*—hay land and/or pasture land which is a part of a regular planned crop sequence or rotation, as contrasted to a permanent pasture or meadow. It may include annual, biennial, or perennial legumes and grasses. The most common ones in Michigan are alfalfa, red clover, ladino clover, alsike clover, sweet clover, timothy and bromegrass.

4. *Permanent pasture*—land occupied by grasses and/or legumes which remain in pasture indefinitely. Included here are unimproved pastures and those areas which have been seeded to grass and/or legume species with the intention that the continuing use of the land will be for pasture. Land, in this category, may have stumps and have some trees—up to 40 per cent of the area may be shaded.

5. *Woodland*—land used for the production of forest trees. This includes land on which it has been determined that the land, prior to planning, was at least 40 per cent shaded, has been reforested, or after planning will be devoted to the production of forest trees.

6. *Orchard*—land devoted to the production of fruit which grows on either a tree or a bush. Such fruits as apples, cherries, peaches, raspberries, blueberries and blackberries are included.

7. *Truck gardening*—land devoted to special crops such as vegetables, mint or strawberries.

8. *Miscellaneous and idle*—this category includes all farmsteads, roads, lanes, fences, idle or unclassified lands, wildlife areas, and any other land not used to produce regular income for the farm.[3]

The data from the sample farm plans in each problem area were tabulated according to the above eight land use categories. The data were then projected to indicate the problem area land use pattern existing prior to any conservation planning and what the land use pattern

Figures 1 - 4 (top to bottom): (1) There is much land like this in Michigan. Formerly used for "permanent pastures" such land would be diverted to woodland and wildlife uses; (2) Orchards, many contoured, would be increased in the major fruit section of the state; (3) Conservation farm planning frequently results in the development of organic soils for truck cropping, such as this field of onions; (4) Some lands cleared have severe soil limitations. Conservation farm planning would lead to reforestation.

[3]For the purpose of this study, there were no designated wildlife pre-planning data available for comparison with the data on land use planned for wildlife in the conservation plan. This is because, before planning, farmers generally did not recognize a use of land specifically designated for wildlife. Thus, in this type of study, there appeared to be no value in showing the acreage as provided for in the plans. Good conservation practices such as strip cropping, fence row management, and farm ponds, while not designated as wildlife areas, do provide some food, cover, and travel lanes for wildlife.

would be following the complete establishment of farm conservation plans on the land. Tabulations and estimates were made in this manner for approximately 450 individual district problem areas.

For analysis purposes, data from the 450 local problem areas were consolidated as follows: First, on the basis of the state's "Type of Farming Areas" and secondly, on the basis of the major Michigan soil associations, as developed by the Michigan State University Departments of Agricultural Economics and Soil Science respectively.

Limitations of the Data

The farm plans upon which this study was based included those developed in each year from 1938 through 1955, with the greater part developed after 1944. Thus the transition period from the pre-planning phase to the complete establishment phase is not universal for all plans included in this study. During 1938-1955, changes were made in the standards utilized in conservation planning. Research, experience, and observation produced new techniques for erosion control and soil improvement.

There were also many changing sociological and economic conditions during the 18 years that exerted influence on landowners in their land use plans. It should not be assumed, therefore, that the indicated percentage changes in land use would be the same percentages that would result if the same lands were all planned in 1958 with present conservation techniques and under 1958 sociological and economic conditions. The trends undoubtedly would be similar but the extent of the indicated land use changes might well be modified by the above factors.

In conservation farm planning the objective is to provide for using land for the purpose for which the land is best suited. There is an objective, e.g., of providing for the production of row crops on lands having little or no erosion hazard—land which generally is the most productive land. The end result of such planning would undoubtedly be an increased yield per acre. This illustrates the fact that the percentage and acreage changes attributed to the effect of conservation planning cannot be directly translated into percentage changes in the output of any farm product. Such an evaluation of the economic effects of conservation planning was not planned as a part of this study. This type of economic evaluation of the effects of planning would have necessitated the obtaining of additional information on the changes in acreages of individual crops, the types of land conditions involved in land use changes at the individually planned farm level, and planned changes in fertility and other improved soil management practices. Further, these data would then have to be expressed in terms of their probable cumulative effect on crop yields.

The data here presented represent net land use changes only.

Interpretation of the Data

A summary of the various land use changes that would be effected in the 16,889,370 acres in the 53 soil conservation districts included in the study following conservation planning are shown in the summary table.

TABLE

Summary—Planned land use changes and percentage of land devoted to various categories of land use before planning and as planned in 53 Michigan Soil Conservation Districts

(Source:—Unpublished data, Erosion and Land Use Studies. Michigan Agricultural Experiment Station.)

Land Use	Before Planning (Acres)	After Planning (Acres)	Increase or Decrease (Acres)	Increase or Decrease (Per Cent)	Before Planning (Per Cent)	After Planning (Per Cent)	Increase or Decrease (Per Cent)
Row Crops	1,890,179	1,549,121	— 341,058	—18.04	11.19	9.17	— 2.02
Small Grains	2,609,428	2,394,828	— 214,600	— 8.22	15.45	14.18	— 1.27
Rotation Hay & Pasture	3,605,687	5,731,839	+2,126,152	+58.97	21.35	33.94	+12.59
Permanent Pasture	2,489,363	1,463,875	—1,025,488	—41.19	14.74	8.67	— 6.07
Woodland	3,532,906	4,084,655	+ 511,749	+15.62	20.92	24.18	+ 3.26
Orchard	368,948	409,864	+ 40,916	+11.09	2.18	2.43	+ .25
Truck Gardening	104,715	119,156	+ 14,441	+13.79	.62	.70	+ .08
Miscellaneous & Idle	2,288,144	1,136,032	—1,152,112	—50.35	13.55	6.73	— 6.82
TOTAL	16,889,370	16,889,370	00		100.00	100.00	.00

The indicated percentage increases or decreases in acreage as a result of conservation planning are as follows: row crops, —18.04 per cent; small grains, —8.22 per cent; rotation hay and pasture, +58.97 per cent; permanent pasture, —41.19 per cent; woodland, +15.62 per cent; orchard, +11.09 per cent; truck gardening, +13.79 per cent; and miscellaneous and idle, —50.35 per cent.

Row Crops—Decreases in the acreages of row crops would occur quite generally over the entire state. Notable exceptions would be in some of the problem areas in the Upper Peninsula which are still undergoing some development for agriculture. The greatest reductions, percentage-wise, would occur in the southern tiers of counties of the state in the livestock and corn, and fruit, dairy and truck areas. Corn is the dominant Michi-

gan row crop and the areas noted represent the main corn growing sections of the state.

Small Grain—Reduced small grain acreages would also be effected in most areas of the state. The only exceptions to this trend were noted in a couple of areas in northern Michigan which would be planned for a small increased acreage. The largest reductions in acreage, both from a percentage and acreage standpoint, would be in southern Michigan. Again this is the main small grain producing area of the state.

Rotation Hay and Pasture—Increased acreages of rotation hay and pasture would occur in nearly all areas of the state. Only in the case of some of the extremely sandy, acid soils was a reduced acreage indicated. In these areas sound land use planning for soil and water conservation would indicate a retirement of much land presently being used for cropland to woodland. In some of the areas in the Upper Peninsula increases would be rather modest. Increased acreages in all other areas would be near 50 per cent or greater.

Permanent Pasture—In general all areas of the state would be planned for greatly reduced acreages of permanent pasture. This would occur as more productive usages were sought for the land formerly devoted to permanent pastures which generally are of the relatively unproductive bluegrass type. The greatest acreage decreases would occur in the sandier areas of western, northwestern and northern Michigan.

Woodland—Woodland acreages would be increased in most types of farming areas. Exceptions are the type of farming areas located in southern and southeastern Michigan and in a portion of the Upper Peninsula where as was previously pointed out some agricultural development is still taking place. Increased acreages, and rather large ones, would result in the drier sandier areas of the northern and western portions of the lower peninsula. Much of the increased acreage apparently would result from the reforestation of land formerly in unproductive permanent pastures, and from land in the miscellaneous and idle category.

Orchard—The major shifts that would be planned in the use of land for orchard purposes would be in the areas along Lake Michigan in the lower peninsula. This geographic area constitutes the major orchard area of the state. Increases for all types of farming areas in this section were quite consistent, running from 13 to 16 per cent. Naturally the increases insofar as soil associations are concerned were planned for those soils in the orchard section which are favorable soils for orchards.

Truck Gardening—The major factor of significance in the trend insofar as land use shifts for truck gardening are concerned would be an increased acreage of such crops following the development of many areas of organic soils. Many such areas are only now under development and apparently many owners would plan for using such lands for truck gardening purposes.

Miscellaneous and Idle—Changes in land acreages devoted to this use were very consistent in direction in all type of farming areas and in all soil associations. The trend in greatly reduced acreages for miscellaneous and idle purposes would result in the diverted acreages being used for other purposes more likely to produce income.

Summary

This study was concerned only with the changes in land use that would be effected by conservation farm planning. No attempt was made to determine the shift in acreages of individual crops that would be brought about and consequently no effort was made to evaluate the effects of such planning on the total production of any agricultural commodity. Fairly consistent trends are noted in the land use changes that a general adoption of conservation plans would bring about. Over most of the area of the state there would be large reductions in the use of land for unproductive permanent pastures and miscellaneous and idle purposes. In many areas substantial acreages of land being used for such purposes would be reforested. Acreages of row crops, and small grains, generally would be reduced and the acreage of rotation hay and pasture generally would be increased.

Additional new effective techniques for soil management and erosion control have been developed since many of the conservation farm plans included in the study were prepared. Soil management practices such as minimum tillage and a better use of crop residues have contributed to the modification of conservation planning standards. Such practices frequently permit a more intensive cultivation of the land than was possible under planning standards that were used in the preparation of many of the plans under study. The fact that these more recently developed practices could not be considered in the study, however, detracts nothing from the significance, as shown in the study, of pointing out the nature of the land use problems in conservation farm planning.

The study indicates that conservation farm planning, using planning standards that were then currently acceptable, would result in an 18.04 per cent reduction in the acreage of row crops. This was necessary because, in overcoming problems of soil erosion and loss of organic matter, more frequent use of the land for soil building crops was needed. Today, minimum tillage and greater use of crop residues are practices which serve to lessen the indicated reduction in the use of land for row crops, and at the same time lessen the extent of the increase in rotation hay and pasture. It is not considered likely, however, that the indicated trends in use of land for other uses would be significantly affected by the newer soil management techniques. ■

Land-Use in New Hampshire—

as affected by soil and slope conditions

HENRY R. ADAMS

AN ANALYSIS OF SOIL SURVEY DATA from about one and a fourth million acres of land in all counties in New Hampshire shows some interesting relations between land use and various soil and slope conditions. The present distribution of land use is the result of a process of selection that has been going on during the 300 years since white men settled in the state. A study of the data shows the nature of the land that farmers have decided is best suited to cropping. It also shows that some conditions that may be highly important in governing land use in other parts of the country have less effect on such use in New Hampshire. Similar studies in New York and Pennsylvania have been reported by Adams (1) and Loughry (2).

The area mapped makes up nearly a quarter of the portion of the state outside of the White Mountain section. The conditions mapped are similar to those found in other New England states and some of eastern New York.

The Soil Conservation Service is participating in a program for obtaining soil survey data from every county in the United States. These data, after they are compiled, may be analyzed to make various interpretations of soil and land use conditions by counties, areas, or states. Besides helping to explain the present land use pattern in New Hampshire and adjoining states, this paper illustrates some of the interpretations that can be made of soil survey data. The factors considered are among those that govern the land-capability classification.

Soils of New Hampshire

About four-fifths of the area studied is covered with a mantle of unassorted glacial till. The remainder has a cover of water-sorted deposits of the same material that has been washed down into the valleys and other depressions. There is also a small acreage of peat and muck. The till material varies in depth from a few inches to several feet, and outcrops of the underlying bedrock are common. Practically all of the till is stony, but the water-sorted materials are essentially stone free.

Starting at sea level, elevations range upward for 5,000 feet, but most of the area mapped is below 1,500 feet. Growing seasons average from 120 to 140 days between killing frosts. The average annual precipitation is from 38 to 44 inches. The country is rolling to hilly, although the water-deposited materials are level or are on gentler and shorter slopes than the ice-deposited till, as shown in Table 1.

TABLE 1

Slope Conditions on Different Soil-Forming Materials

Per cent of area of each kind of material that occurs in each slope class

Soil-Forming Material	*Slope Class*							*Approximate Acreage*
	0-3%	3-8%	8-15%	15-25%	25-35%	35+%	*Total*	
All glacial till	4	21	33	25	14	3	100	1,000,000
Non-stony till	6	42	34	16	2	tr	100	150,000
Water-laid deposits	55	24	10	7	3	1	100	215,000

The glacial till is of two general types: One dominantly of granitic material and the other dominantly from schistose material. The soils formed on the granitic till are gritty sandy loams, somewhat droughty in nature. The schist materials contain more fine particles, and the soils on them range from fine sandy loams to loams and have a greater capacity for holding moisture.

Both groups of glacial-till soils may be further subdivided on the basis of depth to bedrock; the presence or absence of a very compact layer at a depth of 1½ to 3 feet below the surface; and varying conditions of natural drainage.

The water-laid materials range from sands, loamy sands and fine sandy loams in the stream bottoms and outwash areas to silt loams and silty clay loams deposited in the quiet waters of ponds or arms of the ocean. All stages of natural drainage are found.

Land Use in New Hampshire

In the area studied, the present land use at the time of survey was distributed about as follows: woodland 76%, cropland 12%, pasture 7%, idle land 4%, and urban and residential areas 1%.

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It is hopeful that this article will stimulate more interest in and use of soil survey data. Soil Survey Operations has a reservoir of information recorded on punch cards to facilitate analysis and interpretations.

Each of these uses is found on a wide variety of soil conditions. The major part of the cropland, however, is on a relatively small range of soil and slope conditions.

The agriculture is largely poultry raising and dairying and most of the cropland is in hay. Very little land is plowed in any one year, so active erosion is not a serious problem. Past erosion has had little effect on land use except in a few small, scattered areas bordering the Connecticut Valley, where large gullies have been cut by water as it descends from the upland into the valley.

Soil Conditions Affecting the Choice of Cropland

Most of the soils in New Hampshire are naturally low in available plant nutrients but plants on them respond readily to the addition of fertilizer and lime. Differences in natural fertility have not had any great effect on the use of the land.

In making the surveys, an attempt was made to divide the soils into podzols and brown podzolic series. The area represented on the maps is actually a transition zone between these soil groups, but the data do not show any consistent difference in land use between these soil conditions as mapped.

The soil conditions that have had the greatest effect on the choice of land for cropping are stoniness, steepness of slope and moisture conditions. Table 2 gives some examples of differences in the relative acreage of cropland on some selected soil and slope conditions. Some conditions having a very small total area have been omitted from the table.

These data show that as the slope gets steeper a smaller proportion of the land is used for the production of crops. Tillage and haymaking are practiced on land with slopes ranging up to 25 per cent, but less than 0.5 per cent of all cropland is found on slopes steeper than 25 per cent.

There may be several reasons for this adverse effect of slopes such as: More surface runoff on steeper slopes, allowing less water to enter the soil for plant use and creating a greater erosion hazard; the increased draft required to pull implements over sloping land; and the greater possibility of slippage or of overturning power machinery on steep land.

The degree of stoniness outweighs the effect of slope and is the most important single factor in governing the use of land for crops. Less than one per cent of the stony land on tillable slopes is cropped. At least two-thirds of the land in the state is stony, so this condition imposes a severe limitation on the possibilities for agriculture. More than one-third of the so-called "non-stony" land is stone-free only at the surface. It consists of soils on glacial till that is naturally stony throughout but is plowable because of the removal of surface stones by past generations of farmers. The difference between the figures for stony and non-stony till in Table 1 is the result of this activity.

Moisture conditions follow stoniness and steepness of slope in the importance of their effect in governing the use of land for cropping. The amount of cropland on very droughty sands is low. Poor natural drainage also limits the use of land for cropping purposes. The effect of slope is quite different within these two conditions, however. On the droughty soils the greatest cropland use is on level areas from which water does not run off. Instead, it stays there and soaks in to become available for use by the crop. On the poorly-drained soils the reverse is true. A higher proportion of cropland is on the slopes, where water runs off rather than on level areas where water accumulates in or on the soil.

TABLE 2

Per Cent of Area of Each Slope Class That Is Cropped on Selected Soils

Soil Conditions	*Slope Class (Per Cent)*			
Soils on glacial till	0-3	3-8	8-15	15-25
1. Deep, well-drained stony and very stony till	4	1		
2. Non-stony soils on glacial till				
2a. Deep, well-drained granitic till soils	63	60	49	45
2b. Deep, well-drained schistose till soils	74	67	60	53
3. Well-drained till soils with compact subsoil				
3a. Granitic		70	63	47
3b. Schistose	80	69	64	56
4. Shallow, well-drained till soils		38	24	10
5. Moderately well-drained till soils	63	55	48	
6. Poorly and very poorly-drained till soils	25	33		
Soils on water-laid materials				
7. Well-drained fine sandy loam outwash	63	45	27	20
8. Well-drained loam sand outwash	14	9	5	4
9. Well-drained lacustrine silt loam	64	48	44	26
10. Well-drained alluvial fine sandy loams				
10a. Hadley series	83	74		
10b. Ondawa series	72	41		

Soils Favored for Cropland

The highest proportion of cropland is on three general types of non-stony soil:

1. *Well-drained soils on stream bottoms.* (Soil group 10.) The position of these soils in relation to the relatively permanent water table at stream level may account for this high acreage of cropland, since it provides a constant source of water for plant use although the soil is not saturated. The Hadley soils in the Connecticut Valley have a considerably higher proportion of cropland than the other well-drained soils on alluvium. This may be a farmer reaction to a slightly higher lime content in the Hadley. Or it may be a reaction to the flood pattern of different streams. Another possibility is that in this major river valley the Hadley soils occur in broad areas that lend themselves to the layout of crop fields, while

much of the acreage of the Ondawa soils is in narrower valleys.

2. *The deep, open, well-drained soils on glacial till derived principally from schist.* (Soil group 2b.) The higher proportion of fine material in these soils gives them a better moisture-holding capacity than for similar soils from granitic till. The farmers have recognized this difference and the cropland use of the schistose soils is consistently higher on all slopes than it is on the granitic soils.

3. *Well-drained soil on glacial till with a compact layer at a depth of 1½ to 2½ feet.* (Soil group 3.) The compact layer reduces the internal loss of water, so these soils retain a good amount of moisture but not enough to saturate them for more than a few hours at a time. Since the moisture relations are governed by this layer rather than by texture of the soil, there is no appreciable difference between the farmers' choice of schistose or granitic soils for cropping purposes. The proportion of cropland acreage on either type is a little greater than on the schistose soils without the compact layer.

On the other soil groups shown in Table 2, the cropland decreases with the appearance of such conditions as impeded drainage, increasing droughtiness or shallowness to bedrock. In these soil groups the difference in use between the soils on schistose and granitic materials diminishes or disappears, as it is over-shadowed by the other conditions that limit the use of the land, such as wetness or shallowness to rock.

It is hard to explain why the well-drained fine sandy loam and silt loam soils on the lacustrine and marine deposits are not cropped more extensively. They should have the best moisture-holding and nutrient-holding capacity of any soils in the state and are well-suited to hay. They are also the most erodible and occur on relatively short slopes in a dissected landscape.

Choice of Land for Stone Clearing

The conditions that affect the present use of the soils on glacial-till also had their effect in the choice of tracts for stone clearing during the past three centuries. On nearly one-sixth of the acreage of glacial till, the surface is free enough of stones that it can be plowed. There may be a small acreage where this was a natural condition, but most of it is the result of stone-clearing activities by farmers. About one-third of all glacial till areas are classified as being so stony that stone-clearing is not economically feasible. A study of the present surface condition of soils on glacial till that were originally not too stony to be cleared shows direct relationships between the proportion of the area that is now stone-free and the factors of slope, character of the till, and natural drainage. Some representative data are given in Table 3. (The soil groups are numbered as in Table 2.)

Stone clearing is back-breaking work and the farmers cleared only areas that they considered the best or easiest to work. If we assume that the original surface stoniness condition for any soil group was uniform over all slopes, it appears that as the steepness of slope increased the amount of stone clearing decreased. It is interesting to note that even when the land was covered with forest, the farmers selected the soils on schistose till, or those with a compact layer in the subsoil, in preference to the open, somewhat droughty ones on granitic till. This may have been caused in part by the individual stones and boulders being smaller or fewer in number on the schistose till, so they were easier to handle. There is some evidence in early literature, however, to show that the first settlers judged the soils by the character of tree growth on them and selected their plowland accordingly.

Pasture, Idle Land and Woodland

Permanent pasture occupies about 7 per cent of the area mapped. As an essential part of the dairy enterprise it is found on all kinds of land, but is found most commonly on land not well-suited to tillage—stony land, soils shallow to bedrock, land with slopes steeper than 25 per cent, and land with impeded natural drainage. The proportion of acreage in pasture is very low on the very sandy, droughty soils where grass does not thrive.

About 4 per cent of the land was mapped as "idle" since it was non-urban land, not used for cropping, pasture, or the production of timber. About one-fourth of this was on stony land and a small acreage was on extreme conditions of marsh land, river wash or beach sand. The remainder represented land that had been allowed to go out of cropland and pasture. In this case the classification is a temporary one, since if the land is not returned to one of these uses within a few years, it will become covered with trees. The land mapped as "idle" does not necessarily include the poorest land in the state. Much of that was never cleared; or, if cleared, was abandoned years ago and now supports a forest cover.

TABLE 3

Present Surface Condition of Naturally Stony Soils That Are Suitable for Stone-clearing

Per cent of acreage of each slope class in each soil group that now has a relatively stone-free surface.

Soil Group	*Slope Class (Per Cent)* 0-3	3-8	8-15	15-25
2a. Deep, open, well-drained granitic till	68	29	9	11
2b. Deep, open, well-drained schistose till	88	55	28	16
3a. Well-drained granitic with compact layer	84	53	26	15
3b. Well-drained schistose with compact layer	86	60	29	16
6. Poorly and very poorly-drained soils	10	9		

Stoniness is an important factor in limiting the use of land in New England. The stone fence in the left background may indicate that partial stone clearing has been done on the adjacent area.
(SCS Photo.)

The present idle land, therefore, represents the land that farmers have used until recently, but which does not now fit into their farming pattern because of changes in economic conditions, types of farming or the introduction of power machinery. It is found on all types of land, but the greater part consists of the poorest land that farmers have been using in recent years. Relatively high proportions are found on the somewhat droughty till soils, till soils shallow to bedrock, till soils steeper than 25 per cent, and all soils with impeded natural drainage.

Practically all of the state was originally forested and whenever cleared land is not maintained, the trees will take over. The present forest, therefore, is not necessarily on land selected for that use. Instead, it is on all land that has not been selected for some other use or that has proven unsatisfactory and has reverted from some other use.

Summary

A study of soil survey data from about one-fifth of the acreage in New Hampshire shows that about two-thirds of the area is too stony for cultivation. Very little of the non-stony soil is on slopes steeper than 25 per cent. Steepness of slope and soil-moisture relations have had a major influence in the use of stone-free soils, and on the selection of land for stone removal.

REFERENCES CITED

1. Adams, Henry R. *Some soil factors which affect land use in the glaciated Allegheny Plateau of southern New York.* Soil Science Society of America Proceedings, 1946, Vol. 11, pp. 448-451.
2. Loughry, F. G. *Land features influencing use in the middle Allegheny Plateau.* Journal of Soil and Water Conservation, Vol. 3, No. 4, October 1948, p. 168 ff. ■

Field Notes

AGRICULTURE—WHAT IS IT?

IN RECENT years many folks have pointed to the declining number of farms and to fewer and fewer people on farms as evidence that agriculture is decreasing in importance and opportunities. This is a misleading and erroneous conclusion.

Some of the error probably arises from the belief that agriculture and farming mean the same thing. Once they may have, but today there is much more to agriculture than harvesting crops and milking cows.

Farming today is part of a complex network of associated industries which account for more than a third of this nation's annual production effort.

One would not think of the handful of companies manufacturing cars as comprising the entire automobile industry. The makers of special tools, equipment and parts on the one end, and the distributors, retailers, garages, and service stations on the other end are vital segments of a very large and dynamic automobile industry.

Likewise the manufacturers of farm machinery, the commercial fertilizer and feed companies, the producers of insecticides and chemical weed controls are essential parts of an ever-changing agriculture. So also are dairy plants, meat packing companies, flour mills, food stores and all other food processing and distribution firms.

For good data on the size and scope of these industries we need to refer to the 1954 census. In that year American consumers spent $93 billion for farm-originated food and fiber products, or roughly 40 per cent of their total expenditures. The dollar volume has grown since then and no doubt now exceeds $100 billion annually.

The agricultural industries are the largest employers in the nation. In 1954 they employed 24 million workers. Of these, 6 million were in the farm supply industries, 8 million in farming, and 10 million in processing and distribution.

This larger concept of agriculture is growing in acceptance. Some call it 'agribusiness'. I personally do not like the term. It implies a single, simple type of business when in reality we have a complex family of related industries, and it leaves out the 'culture' in agriculture. I prefer, at least for this discussion, to think of agriculture as 'agricultural industries' of which farming is the center or the core.

The fiber of this core is being strengthened through technology, mechanization and management. The core is growing in economic strength with increase in size of unit and greater capital investment. Progress is also being made through organization, but this development is not on a scale and as rapid as is desirable and necessary to keep a proper balance with the related industries and with other segments of our economy. No doubt the rapid changes in farming methods have turned too much attention to those things the individual farmer could do acting alone, and not enough attention to the things that can best be done in cooperation with other farmers. Not that group effort has been forgotten; rather it has received proportionately too little attention.

We are indebted not only to our farms but to all our agricultural industries as a group for much of our abundance in foods, for their quality, variety, wide distribution and for availability at modest prices with services to fit the needs and wishes of consumers. Supplying these products and services will require agricultural industries that expand with our population and our economy.—R. K. FROKER, *University of Wisconson, Madison, Wisconsin.*

SEEPAGE AND SS-13

SS-13 and experiments performed since October 1957, in using SS-13 to reduce seepage in irrigation canals, will be familiar to some readers.

SS-13 consists of resinous polymers and heavy atoms mixed in a carrier of common diesel fuel. Its function is to increase the ionic attraction of the soil particles for water, thus increasing the thickness of the hygroscopic envelope of water around each particle. This decreases the voids or passages through which water can move and reduces the flow through the soil. It tastes like a mixture of water and diesel oil. Apparently few animals like it, and people shouldn't.

Since October 1957 the substance has been tested on several canals. Further testing is being continued by Arizona State University, Tempe, Arizona and the U. S. Bureau of Reclamation.

SOME NOTES ON FERTILIZERS

CHAUNCY O. STANBERRY, soil scientist, Western Soil and Water Conservation Research Division, USDA, University of Arizona, Tucson, Ariz., and SCSA member, is author of an article, "Commercial Fertilizers in Neutral and Alkaline Soil of the West" in the Nov. 1959, *Reclamation Era.* Dr. Stanberry's lead sentence is worthy of repetition: "Misconceptions and lack of information about fertilizer application cost American farmers thousands of dollars each year." He also points out that "biological response to various methods and rates of application is far more complex than commonly believed." And, "total cost per effective unit of required nutrient applied should be the most efficient basis for deciding which source to utilize."

* * *

DR. MAX MORTLAND, associate professor of soil science at Michigan State University, has noted that the rate of release of potassium varies with the degree of weathering, or breaking down, the clay particles in the soil have undergone.

"The rate of release of potassium fixed from fertilizer materials by weathered biotite (clay) is a function of the extent of weathering which the biotite had undergone. The more highly weathered the biotite, the faster the release of fixed potassium."

As rates of release for different fertilizer materials are worked out, fertilizer materials and fertilizer application recommendations can be more nearly tailored to specific soils. Farmers will then be able to get more efficient use of the fertilizers. Michigan farmers spend over $40 million a year on fertilizers.

DAMS—SOME ECONOMIC AND EDUCATIONAL ASPECTS

"WITH the same amount of money planned for three eastern Oklahoma dams, the federal government could pay its share of upstream flood control on more than all the farm and ranch land in the state." This was the lead paragraph of a story in the *Oklahoma City Times* April 18, 1958, written by reporter Hugh Hall who made a private study of combined

federal and local cost figures of Keystone, Eufaula and Oologah dams in eastern Oklahoma and several upstream projects.

Hall found that the per-acre cost of flood-proofing land on representative stream watersheds was $17.98. About half of this is federal cost; local people would pay the other half if landowners would provide free easements. Hall derived a comparison of the two types of projects from dividing the government's half of the per-acre treatment cost into $372 million (the cost of the 3 big proposed eastern Oklahoma dams). Using his figures and applying the amount on the 3 dams it appears that more than 4 million acres of land could be put under upstream flood-control treatment. Oklahoma has about 35½ million acres of farm and ranch land.

Hall made the study not to add fuel to any "big dam-little dam conflict," but to learn how well the upland dams' program was keeping up with the big boys.

* * *

ANOTHER aspect of the economics of big dams is gained from this excerpt from the September 13, 1957, *Jewish Observer and Middle East Review:*

"A new religion, or superstition if you prefer the term, has been gaining ground—especially in the Middle East. It is a very simple faith. It believes that all economic ills can be cured by dams, by the Aswan Dam in Egypt, by the Youssef Pasha Dam in Syria, and by a whole range of dams in Iraq. . . ."

"[Ezra Danin], an Israeli farmer who knows more about growing things in the Middle East, about water and about organized water development than most experts . . . claims that this Damology should not be treated as a faith, but as a myth. . . . There are better, cheaper and quicker ways of raising Egypt's standard of life, and the same applies to Syria and Iraq.

"Consider these two sets of figures. They are more eloquent than any argument.

"The first set of figures shows the annual yield of cotton on one dunum of land (*about one-quarter of an acre*) in four different countries:

Egypt	55 Kg.
Syria	33 Kg.
Iraq	12 Kg.
Israel	100 Kg.

"In Israel after only four years of cotton planting, in the Jordan Valley near Beisan, the record crop of one organized farm area yielded 190 Kg. per dunum.

"Now take the second set of figures. Egypt uses on her heavy soil 2,000 cubic meters of precious water per dunum. Israel uses for a similar soil 500 cubic meters on the coastal plain, and 600 in the Jordan Valley where it is hotter than in Egypt.

"In other words, were Egypt to follow the Israeli method of cultivation she could double her cotton yield without the dam and its vast expenditure of resources and time, and she could enjoy the benefits of this development long before the ten years had elapsed which it will take to build the dam. The same goes for Syria where the opportunity of emulating the improved cultivation practices of Israel is even greater. . . . Careful adherence to scientic considerations and an educated peasantry could do far more for the Arab countries of the Middle East than any amount of American or Russian money expended on grandiose propaganda works like the Aswan scheme."

CONSERVATION EDUCATION EFFORTS

A GENERAL misconception that prevails in much conservation education is that an insight into conservation comes from a textbook. "At best, texts are crude charts telling one which way to go and what one is apt to see.

"Each concept, each idea, law, rule or example is only a porthole from which one's own field experiences may be viewed and evaluated. Without such experiences one has the portholes but no view.

"A conservation teacher must live his subject to make it first real to himself, and then by skillful interpretation instill into the student not only the facts necessary to understand conservation, but a willingness to go afield as well.

"The textbook is only the catalyst which crystallizes field experience into a set of deep-seated esthetic values regarding [any specific field of conservation, i.e., soils, water, wildlife forestry] and conservation as a whole." (Adapted from "Conservation Education vs. False Notions" by ROBERT A. MCCABE. *Wisconsin Academy Review,* Fall, 1958.

* * *

An extremely interesting item, entitled "Conserving and Using Our Open Spaces" makes up the entire issue (Vol. 40, No. 4, May, 1959) of *The Royal Bank of Canada Monthly Letter,* Montreal.

Recently, the U. S. Junior Chamber of Commerce came up with a set of conservation resolutions that received high commendation from the American Association for Conservation Information.

These two events described above, although not precisely connected, seem to show that conservation concepts are proving to be acceptable—an indication that educational and information efforts are paying off.

* * *

Robert H. Giles, Jr., as a graduate student recently at Virginia Polytechnic Institute, undertook to measure in Virginia the effectiveness of conservation education. His study has now been published and can be obtained by writing the Extension Service, VPI, Blacksburg, Va.

Here are some recommendations that stem from Giles' study.

1. That conservation educators devote their efforts to increasing the amount of conservation being taught in public school grades 7 through 9, particularly grade 7.

2. That educators of rural youth re-evaluate their conservation efforts to eliminate the differences in knowledge between rural and suburban youth, and take planned steps to increase the conservation knowledge of rural youth. (It was found that urban youth outscored rural youth.)

3. That conservation agencies cooperate closely with Boy and Girl Scout and 4-H Club organizations for an effective extra-curricular approach to teaching conservation to youth.

4. That all Virginia resource agencies critically evaluate their program of conservation education to account for and eliminate differences in the conservation knowledge of pupils in different parts of the state and of pupils of different race.

5. That the schools assume their responsibility to continue and increase conservation education in the state, integrating conservation training with their activities and in so doing, become the center of a vital and dynamic program.

WATERSHED FELLOWSHIP AVAILABLE

Candidates for the Edward A. Colman Watershed Research Fellowship may obtain application forms by writing to the Committee on Fellowships, 225 Sproul Hall, University of California, Berkeley 4, California. Completed forms must be filed by February 8, 1960.

The award of $1,800 will be made on the basis of merit to a graduate student who is qualified by undergraduate work in hydrology, forestry, range management, soil science, economics, or allied fields, and intends to make watershed management his life work.

The fellowship can be used for research and advanced study in watershed management at the University of California or elsewhere.

CATALOG OF USDA CHARTS

A broad selection of charts illustrating trends in the farm economy, rural life, and food consumption and nutrition is presented in "Catalog of Selected Charts Available from U.S.D.A.," a publication issued by the U. S. Department of Agriculture.

The 55-page bulletin contains reproductions of 572 charts and maps. Charts included in the publication were chosen because they are suitable for general purposes and are of continuing usefulness. Photographic prints, positive photostats, or individual slides of charts shown in the catalog can be ordered from the Department.

Major subjects on which charts are presented are crops, livestock, farm production and productivity, nutrients and food consumption, family living, farm income and costs, agricultural finance, farm real estate, prices and demand, marketing, farm cooperatives, rural electrification, and forestry and forestry products.

Agencies that prepared charts shown in the catalog are: Agricultural Marketing Service, Agricultural Research Service, Foreign Agricultural Service, Farmer Cooperative Service, Forest Service and Rural Electrification Administration.

A free copy of this report, "Catalog of Selected Charts Available from U.S.D.A.", Miscellaneous Publication No. 799, may be obtained from the Office of Information, U. S. Department of Agriculture, Washington 25, D. C.

H. H. BENNETT PROFESSORSHIP

The North Carolina Agricultural Foundation, c/o North Carolina State College, Raleigh, N. C., has established a trust to receive and invest donations made toward the establishment of the H. H. Bennett Professorship in Soils at North Carolina State College. The Brown Creek Soil Conservation District (Wadesboro, N. C.) started the trust with a donation of $500.

WESTERN LAND AND WATER MEETING

On December 16 and 17 a "land and water resources meeting" was held in Salt Lake City, with Soil Conservation District supervisors from 17 western states in attendance. The Public Lands Committee of NASCD, with Bill William of New Mexico as chairman promoted this meeting.

The main purpose of the meeting was to take a look at the operations of the Bureau of Land Management, Bureau of Reclamation, Forest Service, and state agencies that manage public-owned lands.

Those sponsoring the meeting hoped to come up with a united front for a coordinated land and water resources program for the West.

COMING EVENTS

American Society of Range Management will hold its 1960 annual convention in Portland, Oregon, February 2 through 5 with headquarters at the Multnomah Hotel.

National Wildlife Week, sponsored by the National Wildlife Federation, will be observed March 20-26, 1960. The Week will feature the theme of water conservation. Slogan for the observance is: *"Water —Key to Your Survival."* The Federation works through more than 2,000,000 individuals who are members of affiliated groups in 49 states and the District of Columbia.

The 7th annual meeting of the **Watershed Congress** will be held May 18-20, 1960, at the Statler Hotel in Washington, D. C. The SCSA is one of the sponsoring organizations.

AUDIO-VISUAL

Water for Farm and City is a new USDA film released in time for use during Farm-City Week, Nov. 20-26, 1959. It is a 13½ minute film black and white, cleared for TV. It shows case studies of farmers and ranchers across the nation who have learned to apply agricultural water conservation practices—many of which practices are of real value to areas (rural and urban) downstream. Prints of the film are available from all land-grant college film libraries, the regional offices of the Forest Service and the state offices of the Soil Conservation Service.

Conservation Vistas is a new 16 mm. color and sound film, 13 minutes, primarily aimed at teachers and teachers-to-be. It was produced by the Forest Service, USDA, in cooperation with the Milwaukee, Wis., schools. Released Sept. 1958, it is available from regional offices and the Washington, D. C., office of the Forest Service. The film presents classroom and outdoor activities that add interest to conservation teaching. Experiences shown range from the everyday environment to the more ambitious programs of school forests and conservation camps.

There Comes a Tomorrow (16 mm., sound, color, 27½ minutes. 1958.) Available from the U. S. Forest Service regional office, 6816 Market St., Upper Darby, Pa., and state foresters of some 14 Eastern States. Depicts a new approach to the subject of fire control in woodlot management.

Roots and All is a new 16 mm. film in color and sound (16 minutes) that shows how the systematic weedkiller, amino triazole, works. Requests should be sent to American Cyanamid Company, Film Library, Pearl River, New York. (Mention the JOURNAL OF SOIL AND WATER CONSERVATION in your request letter.)

One Billion Acres of Grass is a new 16 mm. color and sound film on grassland farming released by Ray Cunningham and Sons of LaCrosse, Wisconsin. Information on availability of the film for screening and for purchase may be secured by writing to Film Productions Company, 4510 Excelsior Blvd., Minneapolis, Minnesota.

Film-lending libraries in 32 states now have the USDA movie, **Conservation Reserve of the Soil Bank** (16 mm., sound and color, six minutes. Film describes objectives of Conservation Reserve, including wildlife.

Cash in on Grass is a new 22 minute color and sound 16 mm. film released by the National Plant Food Institute in cooperation with the American Grassland Council. The picture describes how the livestock producer can derive greater profits from his pastures and forage crops. For further information on this and other films, write to Film Service, National Plant Food Institute, 1700 K Street, N. W., Washington 6, D. C.

A Way of Life is a new 27-minute full color and sound 16 mm. film produced by the Missouri Conservation Commission, Jefferson City, Missouri. There is revealed a world of nature that many of us fail to see, or recognize—that all creatures, including man, are predator, prey, or some of both and how the life cycle of one influences the lives of others.

Charles W. Schwartz, assisted by his wife, Elizabeth, filmed and directed the movie. The narrative script was prepared by W. O. Nagel. Here is the same team that prepared **Bobwhite Through the Year** and **Cottontail.**

Better Pond Fishing is another award winning Missouri Conservation Commission film. Sound and color, 16 mm. runs for 20 minutes.

NETHERLANDS PUBLICATIONS

A number of excellent publications have been issued by the International Institute for Land Reclamation and Improvement, P.O.B. 45, Wageningen, Holland (The Netherlands). Many publications are issued by the Institute and a complete list can be obtained. The Institute's publication program and world-wide reporting of land reclamation and development have become an important source of information on land and water needs and related technical subjects.

The Annual Report, 1958 (57 pp., illus., no price given), contains several significant papers on land reclamation and improvement and international congresses dealing with land development problems, as well as reporting on internal affairs of the Institute. One paper, "The role of land and water development in world food and agricultural progress" by Rainer Schickele (FAO), pp. 7-22, is followed by a closely-related study, "Agrarian Reconstruction in Europe" by S. Herweijer and P. J. Dieleman, pp. 23-36.

On pages 45-57, there is brief but excellent reporting on the International Seminar on Land Development for Agricultural Uses (Wageningen, 1958) and the Center on Principles and Policies of Land Settlement in Asia and the Far East (Ceylon, 1958).

Other publications that can be obtained through the Institute are:

The Auger Hole Method. By W. F. J. van Beers. 32 pp., 7 figs., 4 graphs in end pocket, appendices. 1958. In English. Bul. No. 1. 60c

Land Consolidation in Europe, 1959. By Erich H. Jacoby. 142 pp., 16 figs., 2 maps in end pocket. 1959. In English. Publ. No. 3. $2.50

Soil Survey and Land Classification as Applied to Reclamation of Sea Bottom Land in the Netherlands. By H. Smits and A. J. Wiggers. 60 pp., 15 figs. 1959. In English, with summaries in French, German, and Spanish. Publ. No. 4. $1.00

Water Deficiencies in European Agriculture: a Climatological Survey. By J. C. J. Mohrmann and J. Kessler. 60 pp., 2 figs., appendices, refs., 10 separate maps in end pocket. 1959. In English, with summaries in French, German, and Spanish. Publ. No. 5. (Price not listed.)

Soil

Soil Moisture Constants and Their Variation. By Walter M. Broadfoot and Hubert D. Burke. 27 pp., illus., bibliog. USDA Forest Service, Southern Forest Expt. Sta. Occ. Paper No. 166. 1958. (No. price listed.) (Reviewed by Richard B. Marston, Columbus, Ohio.)

Students and workers in the field of soil moisture have made extensive use of equilibrium points or other values called soil moisture "constants". Many people are disturbed, however, by some of the extended extrapolations and somewhat indiscriminate applications of these values to related phenomena. The excellent summary, presented in this publication, of a great deal of information gathered from library sources and from many field samples throughout the United States, Alaska and Puerto Rico, shows that soil moisture "constants" vary considerably with the physical condition of the soil.

Arrangement into the following eight main sections gives maximum usefulness to the paper.

1. An *explanation of terms and symbols* gives logical abbreviations or concise definitions of the 33 oft used soil characteristics treated in this report.

2. *Soil-moisture constants and textural relations* are described. Logically, the average value of each constant increases as the coarseness of texture decreases. A full page table gives a compact comparison of the mean and standard deviation of 12 soil-moisture constants by weight. Three diagrams, a full page table showing moisture constants by volume, and another full page table showing them by weight add to the value of this section because samples of coarse, medium and fine texture are grouped under the three classes: surface soils, subsoils, and all soils.

3. *Soil-moisture constants as related to land use and aeration* are presented in tables and a chart. The discovered relations of seven soil moisture constants with total pore volume and with three land-use conditions (forest, old field, and pasture) are especially important in the humid, eastern United States. "The surface soils under forest had better structure than either the old field or pasture soils." They also had more big pores and greater drainage capacity than old field or pasture soils.

4. *Estimation of bulk density from soil properties* is discussed and several regression equations are presented in a table. Pertinent statistics related to these equations are also included in the table. Bulk density is hard to measure. It is of value to know it can be estimated closely by use of organic matter content alone and even more closely by a regression equation that uses the sand fraction and the organic matter content of the soil. The discovery that bulk density was lowest in medium-textured soils, higher in fine-textured and highest in sandy soils is slightly inconsistent and must be due to other factors, such as structure or organic matter, confounded with the effects of texture. Other relations they found that may have many exceptions are: bulk density of pasture soils lower than old field soils and bulk densities in the silt and sandy-clay textural classes higher in the surface layers than in the subsoil layers.

5. *Estimation of "wet" moisture constants* (0 to 5 cm of water tension, 60 cm of water tension, and ⅓-atmosphere of pressure) is treated all in one section. Regression equations and other pertinent statistics are given in a separate table for each of these wet end constants. But for some of the equations they propose, the independent variable is as hard or harder to determine than the dependent variable. For instance, 60 cm contents are best estimated by a multiple regression that uses the soil's sand fraction, organic matter content and big pore proportion. For the ⅓-atmosphere content, the best multiple regression equation uses the soil's sand and clay fraction, organic matter content and bulk density. If the equipment were available, it would be simpler and better to measure the ⅓-atmosphere moisture content directly than to determine all these other variables in order to use the multiple regression equation they propose.

6. *Estimation of 15-atmosphere constant* was one of the most important sections of the publication. This constant has been widely used to delineate the lower limit of

water available for plant growth. A chart shows that it was found to be near the wilting percentage in coarse soils, below wilting percentage in medium textured, and above in fine textured. The best estimating equation uses clay content as the sole independent variable, but here again it would be undesirable to determine clay content to estimate 15-atmosphere moisture, if the 15-atmosphere content could possibly be determined directly.

7. *Estimation of available water capacity* was shown to be possible by the use of other soil properties. Various methods for determining a soil's available water capacity have been proposed. The fact that for some soils one method of calculation gave values twice as great as another should caution anyone desiring to use this soil characteristic. Indeed, extreme caution should be exercised because here medium-textured soils had a higher available capacity than fine-textured.

The best equation for estimating water capacity—using the soil's silt fraction and its field moisture index—seems to be mostly of academic interest rather than a practical method of determination.

8. The *bibliography* contains 111 references. Many of the quantitative values used in this report were taken from some of these references and the methods by which these values were obtained are described in others. Though an extensive list, many others could, of course, have been included. One that certainly should have been included because it contains descriptions of many of the methods of analysis discussed, is: Richards, L. A., Editor. 1954, **Diagnosis and improvement of saline and alkali soils.** United States Salinity Laboratory, U. S. Dept. Agr. Handbook 60. 160 pp.

Broadfoot and Burke's publication is a useful reference for researchers and students. The relations discovered between many commonly used soil characteristics are of great value. By showing that soil moisture constants are far from being fixed, this publication will stimulate careful thinking about their application and use.

Water

Water Facts for the Nation's Future. By Walter B. Langbein and William G. Hoyt. The Ronald Press Company, New York. 288 pages, illustrated, 1959. $5. (Reviewed by EDWARD A. JOHNSON, Columbus, Ohio.)

This new book, the fifth in the Conservation Foundation's Studies in Water Resources, is aimed at water engineers, hydrologists, administrators, legislators and city and regional planners. The book is based on all available data concerning water resources and deserves wide reading. Those who do not want to pursue the technical details will find a resume at the end of each chapter.

This book assesses the achievements—and some serious shortcomings—of present programs of federal and state agencies for collecting, interpreting, and presenting water data. There are suggestions for future expansion and improvement in the light of cost, administration, and publications needed. Steps necessary to enable these programs to furnish information for effective management of our water resources by 1975 are outlined. The central theme of the book is that the greatest need is for better use of existing data rather than for more data.

Watershed researchers will find the introduction "The Meaning of Adequate Basic Data" of interest since it stresses the need for more basic research, understanding of principles, new kinds of information, and avoiding collecting facts that may not reveal anything new or that provide unnecessary details. Three leading questions serve to focus the study: (1) Do the existing basic data programs provide the right information fast enough, and efficiently enough? (2) Is the grasp of relationships keeping up with amassing of facts? (3) Is the best use being made of what already is known? The rest of the book is divided into two parts.

"Gathering Data" is an eight chapter presentation of the current public programs (collecting, publication, financing, etc.). Hydrologic data are discussed first. Land managers of upstream tributaries can see conspicuous omissions of small watersheds when with 6,800 gaging stations now in operation over 75 per cent are on streams draining more than 100 square miles. The authors go on to point out in the chapter on Hydroclimatic Data that growth in the rain gage network using cooperative (free) observers has not kept pace with the stream gaging network. Opinions expressed by the authors on deficiency and problems in the snow program may be at variance with those presented on the panel: Role of Snow Surveys in Soil Conservation and Water Management at the SCSA Rapid City, S. D., meeting.

In the chapter Network Design it is encouraging to see the adaptation of statistics and modern experimental design in planning programs for collecting different kinds of data. The authors proceed to Data on Water Use and Development and point out several illustrations and consequences from the lack of uniformity in the field of water use data.

The next four chapters are devoted to Mapping, Problems of Organization, Cost and Financing of Basic Data Programs, and Publication of Data. The authors feel more can be obtained from basic data than we get now by enlarging the distribution of water facts. Hydrologists will be interested in the discussions on the place for handbooks, topic books for laymen and primers for students.

As indicated by its title, Part II—Data in Action—is a nine chapter presentation dealing with application of present knowledge to several categories of water control, use and management. Readers will find the chapter on Hydroeconomics Design very interesting and several well conceived graphs are employed to point out how uncertainties in streamflow records affect decisions as to size and economic feasibility of a project. The authors have made a distinct contribution of illustrating principles that govern the economic advisability of typical hydraulic works. In the chapter Irrigation the authors make a point of stressing deficiencies in data and discuss how planning, construction and operation of an irrigation project are highly ramified and complex.

In the chapter on Flood Control the authors deal with deficiencies in hydrologic data, damage data, and information for deciding among alternate plans. It seems to the reviewer there are opportunities and need for improvement in flood control and he is at variance with the last part of the authors' statement: "Flood control typifies a field of water resource development where the search for hydrologic data has been good and where the remaining questions are dominately those dealing with an economic nature."

The chapter Streamflow Forecasting emphasizes need for more research relating to precipitation and runoff. Soil and Water Conservation Society readers should find the chapter Upstream Engineering and Land Management very interesting. The authors discuss land use as water use and land management as a part of water management. Need for research is a keynote throughout this chapter. The chapter Waste Water Disposal stresses more study on problems of mechanics of water flow and about action and reaction of chemical, biological and radioactive pollutants. The author selected three kinds of water problems—water supplies, storm water drainage, and flood plain zoning—for illustrating how available water data can be put to wider use for towns, cities and industry.

As the reviewer approached the end of this book he started looking in the chapter Better Data for Better Decisions for concrete recommendations. These are implied

in the authors' three leading criticisms: (1) Distribution of water information over the country is not most effective; (2) Basic data programs have emphasized data collection to the neglect of advancing knowledge of basic principles; (3) Distribution of water facts among those who can use this information is not adequate. Inclusion of more real prescriptions would have strengthened the final chapter.

This book is an excellent introduction to water resources for people interested in the field. The authors are to be congratulated for preparing a volume in which facts on the Nation's water resources are presented in understandable terms.

Water Inventory of the Cuyahoga and Chagrin River Basins, Ohio. By Sherman L. Frost and Robert C. Smith. Vol. 1, 90 pp., illus., bibl.; Vol. 2, Map Supplement. 1959. Division of Water, Department of Natural Resources, 1562 West First Avenue, Columbus 12, Ohio. $6.00, two volumes. (Reviewed by W. E. AKIN, Des Moines, Iowa.)

This is the first in a series of 18 reports to inventory the water resources of Ohio, determine water problems and outline possible solutions to them. The area selected for this first report is one of major economic importance to Ohio since it contains the great industrial complex of Cleveland and Akron. Although comprising only three per cent of the area of the state, it contains one-fifth of the state's population, one-third of the industry, one-fourth of the state's taxable valuable, and four per cent of the agricultural income. With 28 cities over 10,000 in population, and 95 per cent of its 1,740,000 people living in urban communities, industry and urban water problems are paramount.

Basically, the inventory is a report of water facts of the area and not an engineering report in the sense that it diagrams types of water improvements that will be developed. Although technical in many respects, this report is tailored for easy reading by laymen and should have considerable interest for the residents of the area. The report is lavishly illustrated with diagrams, photographs, and maps, and color has been used extensively. Extensive information is included on present water use and probable future needs in the Cuyahoga-Chagrin River basins, quantity and quality of potential sources, problems of floods, drainage and soil erosion, and conclusions concerning the best means of development and control of the water resources.

This series of reports is undoubtedly one of the most ambitious undertakings by any state in the field of water resources inventory. The reports will be valuable additions to the growing list of basic resources inventories in the United States.

The Kansas Basin, Pilot Study of a Watershed. By Charles C. Colby *et al.* 103 pp., illus. 1956. University of Kansas Press, Lawrence, Kansas, $3.00. (Reviewed by W. E. AKIN, Des Moines, Iowa.)

As the title implies, this is a pilot study of a major watershed designed to give a unified picture of its resources and problems, and to serve as a basis for further research. Emphasis is placed on the broad aspects of the distribution, characteristics, and utilization of the natural resources of the Kansas Basin, rather than on detailed analysis in depth of any particular problems. The expressed purpose of this document is to give a working understanding of the resource structure of the Basin which will be of use to those officials charged with making plans and exercising judgment for the future development of the area.

This publication is the product of the Kansas Basin Project, a continuing research seminar of the University of Kansas Graduate School which seeks to bring the knowledge and experience of numerous disciplines to bear on the development of a plan for the wise use of the natural and human resources of the area drained by the Kansas River. Included in the seminar are members of the departments of botany, economics, geography, geology, history, political science, sociology, and zoology, the School of Engineering, and a number of state agencies including the Bureau of Business Research, the Bureau of Government Research, the State Geological Survey, the Natural History Museum, and the State Board of Health. The value of the report is enhanced by the use of 99 maps, charts, and graphs.

A Brief Report on the Study of Governmental Organization for the Water Resources of the Delaware River Basin. By Roscoe C. Martin *et al.* 28 pp., center map of Basin and Service Area. 1959. Water Research Foundation for the Delaware River Basin, Room 948 Suburban Station Bldg., Philadelphia 3, Pa. (No price listed.)

With support of a $131,000 grant from the Ford Foundation, a research team of four Syracuse University staff members have been making a study for the past two years of governmental administration for the water resources of the Delaware River Basin. The complete study, of approximately 500 pages, will be published under the direction of Dr. Roscoe C. Martin, Maxwell Graduate School of Public Administration, Syracuse University, Syracuse, New York. "A Brief Report" is a brief abstract of the longer study.

It is of interest to note that out of the list of 24 officers and directors of the Water Research Foundation, two directors (S. H. Ordway and H. G. Wilm) are members of the SCSA.

A committee representing Delaware, New Jersey, Pennsylvania, New York, Philadelphia and New York City will use the report to draft an interstate-federal compact for creation of a basin agency.

Additional facts on the Syracuse study and previous studies made in the Basin are reported in the Delaware Basin Bulletin, Vol. 1, No. 2, Nov., 1959.

These publications are available free from the Water Resources Association: "Water for Your Ever-Expanding Needs;" "A Brief Report on the Syracuse Study;" and "Water for Recreation—Today and Tomorrow."

Education

Natural Resources. Edited by Martin R. Huberty and Warren L. Flock. 556 pp., illus., bibliog., name and subject indexes. 1959. McGraw-Hill Book Company, 330 West 42nd St., New York 36, N. Y. $11.00. (Reviewed by D. E. Wade, Des Moines, Iowa.)

In the fall of 1955, the departments of engineering at the University of California arranged a series of lectures for staff, students and industry students. Twenty invitational lectures were given by 23 distinguished men. This book, *Natural Resources,* is based on the lectures. Useful and thoughtful introductions are provided through a prologue prepared by Dean L. M. K. Boelter of the College of Engineering of the University of California and a preface by the editors of the volume.

Energy is given a prominent role in the book, but no phase of conservation neglected or omitted. This speaks highly of the lecturers and those responsible for organizing the lecture series.

Each chapter, since based on a self-contained lecture, stands complete. One lecturer, Walter P. Taylor, is a member of SCSA.

All the chapters are thought-provocative, although some require, for a good understanding, better than average knowledge

of mathematics and the field. Certain chapters or parts of chapters will prove heavy going for most readers. This seems true for chapter 15, which deals with certain technical aspects of geophysics; 17, on solar, wind and water-power resources; and 18, on nuclear energy.

A particularly rewarding and helpful chapter is 19 on "Economics and Policies of Resource Conservation" by S. V. Ciriacy-Wantrup. The role of economic forces in shaping the progress or lack of progress in conservation of resources needs more understanding and analysis by all conservationists.

That presently no one single volume on conservation can touch *Natural Resources* for excellence of coverage and presentation seems to be a matter-of-course conclusion after reading it and making comparison with previous publications. Everyone involved in its production should feel elated and be commended. In view of the rather steep price of the book, however, the publishers and the University of California would do well to explore the possibilities of issuing an inexpensive paperback edition. *Natural Resources* is too good not to get a large sales and widespread use immediately. The price tag may be a deterrent to such a desired circulation.

For required background readings, it seems a *must* for any conservation course offered on a college or university level. The man in the field, regardless of what phase of conservation he works, will find the volume most useful for self-improvement. The average public will not be encouraged to buy because of the price.

A Guide to Field Biology. By John Sankey. 166 pp., index, illus., bibliog. 1958. Longmans Green and Co., Inc., 119 West 40th St., New York 18, N. Y. $2.50.

John Sankey is a British educator and for a decade has devoted himself to getting people into field studies in the out-of-doors. In his "guide" he starts with geology, then goes into an excellent section on soils, followed by sections on plants, animals, comprehensive surveys, seashore and estuaries, projects, and appendices of a useful number of techniques.

Because he has done a more thorough job on soils than is usual in such guides, his books deserve critical examination, readaptation and use—particularly on a high school level in the USA and Canada. Educators and field technicians anywhere will find this a most intriguing and stimulating guide. Furthermore such guides are not too common.

Manual for Outdoor Laboratories. The Development and Use of Schoolgrounds as Outdoor Laboratories for Teaching Science and Conservation. By Richard L. Weaver (Editor). The National Association of Biology Teachers. Printed by the Interstate Printers and Publishers, Inc., 19-29 No. Jackson St., Danville, Illinois. 81 pp., illus., 1959. $1.25. (Reviewed by Howard H. Michaud, Purdue University, Lafayette, Indiana.)

In the most recent of a series of publications by the National Association of Biology Teachers, Dr. Richard L. Weaver, Conservation Chairman, has assembled a valuable list of papers that offer suggestions to schools for better use of the immediate environment as a laboratory for outdoor education. This is a much needed volume for teachers of science and conservation who wish to take students into the out-of-doors for an effective understanding of the principles of ecology and how these may be applied to good resource management.

The initial emphasis in this booklet focuses attention on an ideal plan for developing a schoolground outdoor laboratory. This would provide suitable areas for studying and practicing conservation of soil, water, vegetation and wildlife. It would provide space for a school forest, arboretum, picnic area, pond and stream life, wildflowers, demonstration crop plantings, and an outdoor nature museum. It recognizes also the value of planning for outdoor recreation through nature trails, camp woodcraft, fishing and picnicking.

While the plan is beyond the reach of the average school it points out that schools may greatly benefit by (1) developing a master plan with the facilities available, and (2) that any one of the suggestions, or a combination of them, would prove tremendously helpful to the school's program in science and conservation.

The most pertinent merit of the textual information lies in the descriptions of actual cases of schools showing what they are doing to provide outdoor experiences to their students.

Where schools themselves are not equipped for immediate planning of the schoolgrounds there are numerous other community possibilities for conservation and outdoor study.

Any outdoor approach to the study of conservation that is based on scientific principles of ecology is sound. The many suggestions in the volume will instill courage and inspiration to those concerned with effective conservation education. There are many actual descriptions of what to do, how to proceed, and the results that one should achieve in working out-of-doors. Most of the separate papers list references of value related to the topics discussed.

The *Manual for Outdoor Laboratories* is a fine addition to the series of publications on conservation and resource-use by the National Association of Biology Teachers.

Conservation Handbook for Secondary Science Teachers in South Dakota. Prepared by a "Conservation Workshop". 137 pp., illus., bibliog., sources of published materials, glossary. Bulletin No. 78. 1959. Department of Public Instruction, Pierre, S. Dak. (Restricted distribution. No price given.)

A workshop of six persons, meeting for four weeks during the summer of 1958 at Northern State Teachers College, and with the aid of 35 specialists in several areas of resource use and conservation, prepared this handbook. It is intended as a supplement to classroom textbooks in general science, biology, agriculture, chemistry and physics. Interspersed throughout are 58 activities that can be engaged in by students. There is no index. Figure legends are not too easily separated from text typographically.

Soil Conservation Workbook. 48 pp., illus. 1959. Interstate Printers and Publishers, 19-27 N. Jackson St., Danville, Ill. 75c

Aimed at the elementary school level, this well-illustrated "work" booklet should prove to be most useful to teachers, especially if combined with **This Is Our Soil** by Ernest D. Walker and Albert B. Foster (Interstate).

The Land Below Us. (Prepared by the Field Information Unit, SCS, Spartanburg, S. C.) 1958. 16 pp., illus. 9 x 13 inches.

Apparently this publication was used by Southern Air Lines on all their planes. By reference to the illustrations, a passenger gains some interpretation of land below. A very worthwhile publication that should serve to stimulate more activity on the part of conservationists to promote such booklets for use on all air lines.

Women in Soil and Water Conservation by Mrs. Don G. Fredericksen. (Available from Mrs. Henry W. Bethea, President of the Women's Auxiliary of NASCD, Newberry, Florida. 25c.)

This is largely a history of the Women's Auxiliary of the NASCD.

An Inexpensive Science Library—A Selected List of Paperbound Science Books. Compiled by Hilary J. Deason, 38 pp., index (by authors). Second edition, 1958. Published by the American Association for the Advancement of Science, 1515 Massachusetts Ave., N.W., Washington 5, D. C. Price, 25c

Although this is an important and excellent list of inexpensive publications, there is a definite lack of books listed on conservation topics. Reprinting of selected "conservation" books in inexpensive, paperback editions would seem to be worth investigating and promoting.

Extension Service Review, Vol. 30, No. 6, June 1959, pp. 122-144. Single copies can be purchased from the Supt. of Documents, Govt. Printing Office, Washington, D. C. at 15c each.

For a quick review of progress and a forward look at natural resources and conservation here is a neat package. Although emphasis is on agricultural lands, various brief articles discuss urban sprawl, public domain lands, watersheds, fishponds, fish and wildlife, Alaska, and education.

Adult groups and organizations wishing an easily read but factual presentation, would do well to purchase an ample supply of this issue of *Extension Service Review*.

Summary of CRUE Project Conference for State Departments of Education. 44 pp. 1959. Joint Council on Economic Education, 2 West 46th St., New York 36, N. Y. (No price listed.)

The results of a three-day work conference held in Washington, D. C., December 15-17, 1958, and sponsored by CRUE (Conservation and Resource-Use Education Project) of the Joint Council on Economic Education. Several members of the SCSA participated as consultants. A worthwhile summary for anyone responsible for conservation education on a teaching or training level.

Education for Planning: City, State and Regional. By Harvey S. Perloff. 189 pp., index. 1957. The Johns Hopkins Press, Baltimore 18, Md., for Resources for the Future, Inc. $3.50. (Reviewed by W. E. AKIN, Des Moines, Iowa.)

Rapid urbanization and the spread of industrialization has brought increasing pressure on water, land and energy resources and has brought about an increasing awareness of the necessity for planning on city, state and regional levels. This book considers the kinds of persons to be recruited for the planning tasks ahead, the training to which they should be subjected, and the adequacy of our institutions of higher education to give this training.

The book is divided into three parts: (1) Education of City Planners: Past, Present, and Future; (2) Education for Regional Planning and Development; and (3) Education and Research in Planning. In this last section is a review of the University of Chicago experiment in education for planning which was unique among such programs in that it emphasized theory, was grounded mainly in the social sciences, included practical training, and placed a strong emphasis on research. Appendices following parts I and III include historical landmarks in planning and related education in the United States, degree requirements in planning at the University of Chicago, and a list of publications by members of the University of Chicago Planning Staff.

Keeping Abreast of Change—An Inventory of a Rapidly Changing Rural America. Compiled by Phillip F. Aylesworth. 35 pp., appendix on marketing and price support program, bibliog. 1959. Federal Extension Service, U. S. Dept. of Agric., Washington 25, D. C. (No price listed.)

Brief summaries of changes in population, structure of farming, community; measures of changes; and implications. Necessarily sketchy in measuring certain sociological aspects because of limited data.

The Why and How of Rural Zoning. By Erling D. Solberg. 58 pp., illus. 1958. Agr. Inf. Bul. No. 196. Supt. of Documents, Washington 25, D. C. 40c

Zoning, in view of large changes that are now rapidly underway on the land, is due for re-examination and up-dating. This is a helpful booklet.

Science and Resources: Prospects and Implications of Technological Advance. Henry Jarrett (editor). 250 pp., index. 1959. Johns Hopkins Press, Baltimore 18, Maryland. $5.00.

Through a series of six public lectures in Washington, D. C., sponsored by Resources for the Future, this book became possible. The essays—there are 18—stem from the series of lecture discussions and touch on genetics, weather modifications, exploring for minerals, chemical technology, nuclear energy, and new knowledge from outer space.

In a large sense this volume supplements a previous series of lectures sponsored by RFF and reviewed on page 86, Vol. 14, of the JOURNAL. Editor Henry Jarrett of RFF has prepared a most useful introduction which in its own way adds another essay to the volume. He greatly aids and stimulates the reader in raising questions and projections. His end remarks point to one of the great values that ought to be expected from discussions such as here presented in this distinguished volume: "More and more, as technology advances, must planners, administrators, and ordinary voters be aware of the physical and biological possibilities of their plans and aspirations; and scientists and technologists must recognize the social and economic meaning of the applications of their research."

The contents of this book, if they could be incorporated into formal education seminars and courses—especially in colleges and universities and other schools responsible for training scientists and technicians — would have beneficial impact. As one reads over the essays, there arises a desire to have tape recordings of the original presentations. Such recordings could be aired on radio and before discussion and forum groups desiring to discuss seriously the "prospects and implications of technological advance" as applied to natural and man-made resources.

Readings in Urban Geography. By Harold M. Mayers and Clyde F. Kohn (editors). 625 pp., author and subject indexes, illus. 1959. University of Chicago Press, 5750 Ellis Ave., Chicago 37, Ill. $8.50. (Reviewed by WALLACE E. AKIN, Des Moines, Iowa.)

The editors have selected representative articles from the diverse literature on cities scattered through the professional journals. Most of these articles date from the period since World War II and reflect the present-day trends in research and give a comprehensive review of the field of urban geography. The articles are grouped under 18 sectional headings including such topics as: The Rise and Growth of Cities; The Economic Basis of Cities; Classification of Cities; The City's Water Supply; and Blight and Renewal.

This collection of works on the city is a welcome addition to the geographic literature in view of the fact that there has been no major work in the English language which adequately treats the subject of urban geography.

The Bombing of St. Louis: Report and Epilogue. (Reports by a Physicist, a Doctor, and a Housewife.) *Saturday Review,* Nov. 28, 1959, pp. 15-18, and 40. (Reprints of the article are available from the St. Louis Citizens' Committee for Nuclear Information, Room 318, Museum of Science and Natural History, St. Louis 5, Missouri. There is a modest charge for reprints.)

The naked realism of nuclear warfare and the awful relationships to natural resources make this a top-priority item to be read and taken to heart by human beings anywhere.

The St. Louis committee has brought vivid understanding to the meaning of facts presented in June 1959 before the Holifield subcommittee on radiation of Joint Congressional Committee on Atomic Energy.

Abatement of atomic explosions and utter prevention of nuclear warfare seems to be one of the great—if not the greatest—conservation problems facing the world today.

The devastating and long-time effects of nuclear explosions on 70 key-target cities and large contiguous sectors of the USA—especially on structures, soils, crops, food supplies, other commodities of life, water supplies and human beings—are seriously weighed *and documented* in the "reports." The reprint is worthy of earnest discussion by conservation and other organized groups.

Not much imagination is required to think of what might be done with these reports by some top film producer—e.g. Walt Disney. Here could be an epic film worthy of thousands of Nobel awards and the eternal gratitude of human beings worldwide. Perhaps this is being accomplished, in part, by the new film, "On the Beach," and book by same title authored by Nevil Shute.

The Future Supply of Oil and Gas. By Bruce C. Netschert. 134 p., index, 19 tables. 1958. Published for Resources for the Future, Inc. by the Johns Hopkins Press, Baltimore 18, Md. $6. (Reviewed by W. E. AKIN, Des Moines, Iowa.)

This study attempts to estimate the resource base for petroleum and natural gas in the United States and adjacent continental shelf. The author concludes that there are on the order of 500 billion barrels of oil and 1.2 quadrillion cubic feet of natural gas in this area, although this quantity probably will never be exploited in full.

This study is an non-traditional approach to the evaluation of a resource in that it does not depend on the concept of "proved" reserves, and stresses the role of developing technology as a dynamic factor in the future availability of oil and gas.

Environmental Relationships of Plants and Animals is a series of six articles prepared by seven authors and published in the Sept. 1959 (Vol. 40, No. 9, pp. 528-549 & 551) *Agricultural Engineering.* Single copies of the issue can be obtained from Agricultural Engineering, 420 Main St., St. Joseph, Mich. at $1.50.

The articles represent in large part a pioneer entry by agricultural and thermal engineers into certain assessments of the "relations of the production and well-being of plants and farm animals to their thermal environments."

Wildlife Conservation. By Ira N. Gabrielson. 244 pp., illus., index. 1959 (2nd Edition). The Macmillan Company, 60 Fifth Ave., New York 11, N. Y. $5.50.

The first edition of Dr. Gabrielson's book appeared in 1951. In the 1959 edition he has added a chapter on the effects that changing practices in farming have had on the present impending scarcity of wildlife. There is an interesting discussion of the theory of using land according to its capabilities. The system, he states, "if carried out literally and completely [from an agricultural standpoint] would relegate wildlife largely to the land that is not fit for anything else." Dr. Gabrielson—an honorary member of SCSA—recognizes the potentials for benefiting wildlife inherent in soil and water conservation practices. But he makes clear that there is greater need for wildlife interests to work with and understand trends in manipulation of agricultural lands.

Agricultural conservation (Soil Bank) payments, industrial farming, pesticides, and drainage are discussed.

This second edition is a great improvement over the first, and should be a worthy addition to the library of land and water technicians anywhere. Dr. Gabrielson writes objectively and knows his subject exceedingly well.

Historical Forestry Statistics of the United States. Compiled by Dwight Hair. 22 pp., 22 tables, Appendix. Statistical Bul. No. 228, USDA, Forest Service. 1958. U. S. Govt. Printing Office, Washington 25, D. C. (No price listed.)

Reporting Agriculture Through Newspapers, Magazines, Radio, Television. By William B. Ward. 401 pp., illus., indexed. Comstock Publishing Associates, 124 Roberts Place, Ithaca, N. Y. $5.00. (Revised ed. 1959.)

In 17 compact chapters, this book deals with an up-to-date approach in writing and broadcasting agricultural information for the major media of mass communications.

A practical guide which uses many case histories.

Interviewing Procedures: A Manual for Survey Interviewers. By J. Stacy Adams. 56 pp., 1958. The University of North Carolina Press, Chapel Hill, N. C. $1.00.

A balanced discussion on interviewing with a presentation of basic general principles and procedures. The rationale behind the art and science of interviewing is given. Suggested readings, a glossary, and index round out this valuable booklet which has much to offer any person or group responsible for planning and conducting survey interviews.

—SCSA—

NEW CONSERVATION PUBLICATION

Resource-Use Review is a new and excellent publication of the Conservation and Resource-Use Education Project (CRUE) of the Joint Council on Economic Education, 2 West 46th St., New York 36, N. Y. (No price listed.)

The first issue of the *Review* appeared this summer. With three columns to a page, the 12-page, 9 x 12 inches, issue covers an unusually fine spread of news and information valuable particularly to those who are concerned with conservation education. It is edited by George L. Fersh, who is a member of SCSA and director of CRUE.

Undoubtedly an examination copy can be obtained by those who feel they have a bonafide use for the *Review.*

In the conservation education field, outside the publications of the Conservation Education Association, the *Review* is unique. In this reviewer's opinion the Joint Council on Economic Education through this publication, which presumably is to be issued quarterly, is on the right trail. The *Review,* as evidenced by the coverage and high quality of the first issue, needs wide distribution. It should prove to be one of the important publications in conservation education.—D.E.W.

News Notes

PRESIDENT'S COLUMN

THE PRESIDENCY of the Soil Conservation Society of America is a signal honor and a real responsibility. I deem it a privilege to be accorded the confidence of the Society members by election to this office.

The Soil Conservation Society of America is a vigorous, growing organization that is going places. We have over 10,000 members in all 50 states and 75 foreign countries. Interest and enthusiasm are growing—as evidenced by attendance at chapter meetings and at recent National Annual Meetings. At Rapid City, South Dakota, over 2,000 members and their families from 49 states, Canada, and four foreign countries were present. We have 30 working committees engaged in meaningful activities.

We cannot rest on our laurels, however. The job ahead is great and only by everyone pitching in and working can we accomplish our objectives. January is inventory time and also the time when resolutions are made, hence, it is well that we, the members of the Soil Conservation Society of America, take stock of our organization and what we are doing. Let us first review the objectives of the Soil Conservation Society of America:

Article II, Section 1, of the By-laws of the Society, outlines the objectives: "The objectives of this Society shall be the development and advancement of the science and art of good land use and management and the promotion of conservation of soil, water and related renewable natural resources including, wtihout limitations, trees, grass, fish, wildlife, and all other forms of beneficial plant and animal life and for these purposes to employ edu-

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Are we working toward obtaining these objectives? We see much in the press regarding, on the one hand, "the deplorable farm surpluses," and on the other hand. "the exploding populations and the need to hold down population so that we might adequately feed and clothe the people." Society members in their appraisal of such statements should give serious thought to solution of demographic problems and their relation to world agriculture.

We Americans owe a special debt of gratitude to our farmers and ranchers. What is so bad about having an agricultural surplus? Would the critics prefer starvation conditions such as exist in some less developed countries? The productivity of our farms and ranches has supplied abundant quantities of food to consumers, raw materials to industry and also has released manpower for the needs of the total economy.

In producing this abundance we must so use, improve and conserve our soil, water, and related renewable natural resources that they may be enjoyed by mankind in abundance forever. All people, rural and urban, have the moral responsibility to conserve and develop our God-given resources of soil, water, forests and wildlife. The man on the land has a particular moral responsibility, as a steward of the soil, to improve and conserve the land he operates.

Society chapters form the "backbone" of the SCSA. While individual action is essential, the power of SCSA lies in active chapters where individuals in groups can accomplish much through cooperation. The attainments of the Society and the Society's growth and vigor have been brought about by militant, progressive chapters. Let's all "put our shoulder to the wheel" to activate to the fullest extent our local chapters.

Society plans for 1960 include: Increase membership participation in chapter activities and programs; increase Society membership; work toward securing a new home for the Society; further the Development Fund Project which will provide scholarships and fellowships; carry out special projects of the Society's committees; and expand the Society's Publications program. This year we are meeting in the new Sixth Area of the Society at Guelph, Ontario, Canada, August 27-31. Canadian area Councilman, N. R. Richards, Department of Agronomy, Ontario Agricultural College, Guelph, Ontario, is chairman of the 1960 Annual Meeting Program Committee. Our Canadian members and Secretary Pritchard have been working for over two years to assure a program and entertainment that none of us will want to miss.

Keep the communication lanes open on any subject mentioned here, or any other Society items. I assure you that the officers and members of the Council of the Society are most anxious to serve you, the membership, in accordance with your wishes. We welcome your suggestions, encouragement and criticisms. There are over 3,000,000 organizations of all types in the United States. Each organization is capable of great good if its members strive wholeheartedly to see that it serves a noble purpose. However, all organizations are made up of human beings and there is a constant tendency to (1) lose sight of objectives, (2) get "bogged down" in trivialities, (3) let the running of the organization be done by just a few of the members (who need the help of all members to succeed). You, the membership, are the Society. —ELMER L. SAUER, *President.*

CALL FOR NOMINATIONS

NOMINATIONS are being accepted for Society officer and council positions. Nominations will be open for all the offices and for the council positions in the Northeast and North Central Regions and for one council position at-large. Present incumbents respectively in these council positions are John Barnard, Minott Silliman, Jr., and Firman E. Bear.

There are some rules in the nomination procedures. Complete information is contained in the Bylaws which are available from the SCSA office in Des Moines or from chapter officers.

Nominations should be submitted to Herschel Hecker, chairman of the Nominations Committee, 317 Greenbriar, Lexington, Kentucky, and must be received by him not later than April 29, 1960.

* * *

Nominations for Fellows and Honorary Members should be sent to the Executive Secretary of SCSA in Des Moines, Iowa, and must reach him not later than May 30, 1960. Full information for determining the qualifications for these SCSA honors is

available from the Executive Secretary. J. C. Dykes of Washington, D. C., is serving as chairman of the Fellows and Honorary Members Committee.

* * *

In 1959, Merit Awards were instituted by the Society and two Certificates of Merit were presented (see page 284 of the November, 1959, JOURNAL OF SOIL AND WATER CONSERVATION). Further details on Merit Awards will be sent to chapter officers early in 1960.

SOIL STAMP STILL AVAILABLE

According to the *Western Stamp Collector*, ". . . the charm of the 4 cent Soil Conservation stamp design as a result of its reproduction in three colors will probably make it the No. 1 U. S. postal adhesive for 1959."

Then, view the accompanying picture.

D. Staton Inscoe, Raleigh, North Carolina, Postmaster, hands several sheaves of the Soil Conservation commemorative stamp to Miss Nancy Adams, secretary-treasurer of the North Carolina SCSA chapter on August 27, 1959. This scene was duplicated in many postoffices throughout the nation on August 27 when the stamp was released to the general public and many conservationists and conservation organizations purchased large supplies.

Postmaster George W. Lampert of Rapid City, S. D., writes that the soil conservation stamp is still available in large numbers and requests made through your local postoffice will insure a fresh supply, if your local P. O. is out.

—SCSA—

THEME for 1960 Annual Meeting is "New Technologies in Land Resource Management." MEETING PLACE: Guelph, Ontario, Canada. DATES: August 28-31, 1960.

SOCIETY COMMITTEES AND CHAIRMEN

Annual Meeting Program—N. R. Richards, Dept. of Soils, Ontario Agricultural College, Guelph, Ontario, Canada.

Annual Meeting Local Arrangements—L. R. Webber, Dept. of Soils, Ontario Agricultural College, Guelph, Ontario, Canada.

Annual Meeting Publicity—Herb Crown, 454 University Ave., Toronto, Ontario, Canada.

Archives—T. S. Buie, 3120 Duncan St., Columbia, South Carolina.

Awards—Herbert A. Hopper, 3374 Mt. Diablo Blvd., Lafayette, California.

Building Fund — Harold M. Rhodes, Route 3, Morgantown, West Virginia.

Booklet Sales—Jack L. Barrick, 300 Main St., Burlington, Vermont.

Chapter Activities—I. O. Hembre, Room 1, Soils Building, College of Agriculture, Madison 6, Wisconsin.

Editorial Board—Ben O. Osborn, Soil Conservation Service, South Agriculture Bldg., Washington 25, D. C.

Elections—R. A. Wilcox, Soil Conservation Service, 405 Iowa Bldg., Des Moines 9, Iowa.

Fellows and Honorary Members—J. C. Dykes, Soil Conservation Service, Washington 25, D. C.

Finance—Minott Silliman, Jr., 929 S. Myrtle St., Kankakee, Illinois.

Housing—J. S. Russell, Register & Tribune Bldg., Des Moines, Iowa.

International Relations—Glenn K. Rule, Soil Conservation Service, South Agriculture Bldg., Washington 25, D. C.

Land Utilization—Frank W. Schaller, 131 Agronomy Bldg., Iowa State University, Ames, Iowa.

Membership—George L. Winchester, P. O. Box 1226, Raleigh, North Carolina.

SCSA Office Procedures—Carl H. Dorny, Soil Conservation Service, Washington 25, D. C.

Nominations—Herschel E. Hecker, 1409 Forbes Road, Lexington, Kentucky.

Organization and Policy—Val W. Silkett, Soil Conservation Service, South Agriculture Bldg., Washington 25, D.C.

Public Policy—Lloyd E. Partain, The Curtis Publishing Co., Independence Square, Philadelphia 5, Pennsylvania.

Professional Training—Arnold W. Bolle, School of Forestry, Montana State University, Missoula, Montana.

Program Development—Walter C. Gumbel, P. O. Box 1392, Fairmont, West Virginia.

Spanish Glossary—William H. Gracia, 1409 Ponce de Leon Ave., Santurce, Puerto Rico.

Special Journal Awards Study—A. L. Patrick, 4228 S. Columbia Road, Apt. 21, Arlington 4, Virginia.

Special Publications—D. Harper Simms, Soil Conservation Service, South Agriculture Bldg., Washington 25, D. C.

Student Chapters—Robert M. Hanna, College of Agriculture, Rutgers University, New Brunswick, New Jersey.

Water Resources Management—Walter C. Gumbel, P. O. Box 1392, Fairmont, West Virginia.

* * *

The SCSA also has representation with the following organizations, with the representative named:

American Association for Advancement of Science—Donald A. Williams, c/o Soil Conservation Service, South Agricultural Bldg., Washington 25, D. C.

American Grassland Council—B. D. Blakely, c/o Soil Conservation Service, South Agricultural Bldg., Washington 25, D. C.

International Union for Conservation and Protection of Nature—Dr. Edward H. Graham, c/o Soil Conservation Service, South Agricultural Bldg., Washington 25, D. C.

National Watershed Congress—Alvin C. Watson, c/o Soil Conservation Service, 7600 West Chester Pike, Upper Darby, Pa.

Natural Resources Council—Dr. Edward H. Graham.

Policy Committee for Scientific Agricultural Societies (Scientific Manpower Commission)—John W. Barnard, 4306 Underwood St., University Park, Hyattsville, Md.

Conservation Education Association—(to be filled).

LETTER

I have just seen the November 1959 JOURNAL OF SOIL AND WATER CONSERVATION including the review of "Technology in American Water Development." Both Dr. Löf and I are grateful for the good opinion and for the care which was taken in reviewing the book. After looking over a number of perfunctory reviews, it is always refreshing to come across someone who has read and understood what he has read.

EDWARD A. ACKERMAN

INFORMATION ON 1960 CONVENTION GUELPH, ONTARIO, AUGUST 28 - 31

THE FIFTEENTH ANNUAL MEETING of the Society will be on the campus of the Ontario Agricultural College, Guelph, Ontario, Canada, on August 28-31, 1960. The sessions are scheduled to be held in the new Physical Education Building with a seating accommodation for 2,000 people, meeting rooms, cafeteria, and swimming pool. Breakfasts and lunches will be served in the College Dining Hall; evening meals are a special feature of the Meeting and will be served at the Physical Education Building.

To assist the membership in planning for this convention this issue of the JOURNAL and succeeding ones will contain the information you will need.

Accommodations

The Local Arrangements committee is planning to house in the College dormitories those members who bring their families unless you specify otherwise. We have been assured of 750 beds on the campus (no maid service), usually 2 to 4 per room. The College charges $1.50 per bed per night. Local hotels and motels, within 15 miles of Guelph, can handle around 1,200 people. If you prefer to see more of Ontario, then we can locate an additional 500 people within 20 miles of Guelph. To be assured of the type of lodging you want use the pre-registration form in the next issue of the JOURNAL.

Automobile Travelers

Most delegates will enter Ontario at Niagara, Windsor, Sarnie, or Sault Ste. Marie. All points of entry maintain a tourist information booth for your convenience and these people will be most happy to give you road and lodging information for your trip to Guelph. In this country we drive on the right side of the road and remember that when you pay more for your gasoline it is the big Canadian gallon you are buying.

Airline Travellers

Secure your airline tickets to the Toronto-Hamilton airport at Malton, forty miles from Guelph. We urge you to use the pre-registration form, next issue, to be assured of a motel or hotel accommodation in Guelph and prompt transportation to and from the airport—courtesy of the Ontario SCSA Chapter.

Future issues of the JOURNAL will detail the procedures for those flying their own planes directly to Guelph.

Railroad Connections

Guelph is served by two major railroads, Canadian National and Canadian pacific, and is on the lines between Toronto and Detroit and Port Huron. If your train enters at Niagara or Sault Ste. Marie you will go to Toronto and transfer to a train for Guelph.

How to Enter Ontario

American drivers should carry vehicle ownership registration, and driver's license. While some states do not require the ownership of registration to be carried, it is required at border points and when driving in Ontario.

Permanent U. S. residents do not require passports but for convenience it is advisable to carry some alternative identification. Naturalized U. S. citizens must carry naturalization papers and aliens proof of legal residence in the U. S.

Tariff Regulations

U. S. citizens who have been in Canada for 48 hours are allowed by their tariff regulations to take back, duty free, up to $200.00 worth of merchandise per person. This exemption is allowable every 31 days. For complete customs regulations check with your customs officer on entering Ontario or write the Canadian Government Travel Bureau, Ottawa, Ontario.

U. S. Money in Ontario

The difference in the rate of exchange fluctuates daily but generally the day to day difference is negligible. Your money can be exchanged at any bank in Ontario; most places of business will accept your money at the current rate of exchange. We urge you to obtain Canadian money or traveler's checks payable in Canadian currency at your own bank before you leave. We regret that U. S. money offered at Meeting registration will have to be discounted in accordance with the current rate of exchange.

Camping Facilities

If you plan to camp in Ontario prior to or after the Meeting all details will be sent to you by writing Ontario Department of Travel and Publicity, 67 College St., Toronto 2, Ontario.

If you plan to camp while attending the Convention, be sure of a site at a camping park near Guelph, by writing; Mr. G. M. Coutts, 27 Dickson St., Galt, Ontario.

15th Annual Meeting

▶Registration will commence Sunday afternoon and to be followed by the LONG-TIME SUPPER from 5:00 to 8:00 p.m. in the Physical Education Building and an evening of entertainment.

▶Monday—sessions in the morning and afternoon with the UPPER CANADA PROGRAM in the evening.

▶Tuesday—sessions in the morning; box lunch while on the afternoon tour; OLD ONTARIO BARBECUE at night with entertainment.

▶Wednesday—sessions in the morning; business meetings in the afternoon.

▶Ladies program for Monday and Tuesday includes special shopping tours for woolens, china and linens; visit to the Botanical Gardens and homes well-known for their architectural design; and coffee and tea parties.

▶Children's program—under the direction of trained personnel during the sessions. Sitters available for evenings.

▶Recreation facilities available on the campus include tennis courts and a swimming pool with life-guards. A pay-as-you-play golf course and riding horses are near by.

PLAN NOW to attend the Society's 15th Annual Meeting at Guelph, Ontario, August 28 to 31.

To the Editor:

Current attempts are being made to dilute the significance of the word, "conservation", and, in fact, to dispense with it. Specifically, I submit that the term, "outdoor education", is a weak and misleading substitute. Yet this substitution was suggested openly at a recent, high-powered resources conference.

No doubt, the proponents of the expression, "outdoor education", are purely motivated. One judges they feel this is streamlined English with popular appeal. On their side, it must be admitted that "conservation" has often suffered from lugubrious, flat-footed promotion.

Still, this seems an inadequate excuse for discarding a word, which through long years of back-breaking effort, has finally come to mean the many bodies of knowledge and philosophy wrapped up in the definition, "wise use of natural resources." To undercut this signal achievement in human understanding, would bring confusion to millions throughout the world.

"Outdoor education" is indeed an attractive phrase and an accurate label applied to hunting, fishing, camping, archery, nature appreciation and so on. It should serve admirably in drawing multitudes closer to an insight on the true, sweeping character of *conservation*, itself.

But to try to synonymize one with the other is like pointing out a single tree and claiming it to be the entire forest.

BERNHARD A. ROTH

On To Ontario in 1960

For The Fifteenth Annual Meeting of SCSA

A FRIENDLY WELCOME awaits as you enter Ontario—the second largest province in the Dominion of Canada, home for one-third of the country's population, and producer of half of the nation's manufactured goods. Now over ninety years old the province has grown rapidly from its early beginnings as an agricultural community until today the value of manufactured goods is over twelve times that of agricultural production.

The manufacturing economy is varied; motor vehicles, machinery, aircraft, pulp and paper, meat packing, and metal refining are the leading industries. The abundance of cheap water power and the good transportation facilities have resulted in the substantial industrial development. The advantageous position of Ontario on the Great Lakes facilitates the economical transport of import and export goods. Canada leads the world in the production of newsprint, nickel, asbestos, and platinum.

Despite the rapid advance in manufacturing, the total agricultural production in Ontario surpasses any other province. Three-quarters of a million people are dependent on agriculture for their livelihood. Southern Ontario possesses a moderate climate and a wide range of soils which enable farmers to produce a greater variety of crops than elsewhere in the Dominion. Fruits and vegetables are grown in the fruit belt, a narrow strip of land between Lake Ontario and the Niagara Escarpment and in several locations along Lake Erie and Lake Ontario. The extreme southern tip of the province lies on the same latitude as northern California. Tobacco is successfully grown in the sandy soils in the southern part of the province. You will find in Essex and Kent Counties a corn-bean-hog-beef enterprise similar to your mid-west. Beef raising is common to the north of the cash-crop area; the huge dairy industry is concentrated around most large cities.

Enter at Sault Ste. Marie — 500 Miles to Guelph

YOU will cross the St. Mary's River by ferry; ships use the Soo locks—the busiest in the world. East on Route 17 you will pass near the world's richest uranium mine at Elliot Lake and through the Sudbury district that produces ninety per cent of the world's nickel. The next two hundred miles are through Ontario's famous recreation country where you will find resorts to suit every taste and purse—from luxury hotels with every convenience to the quiet lakeside cabins for relaxed vacationing. Ontario has two hundred and fifty thousand lakes—many of them in the Precambrian Shield—forty thousand lakes are waiting to be named. To your right off in Georgian Bay are the Thirty Thousand Islands. At Orillia, just a hundred miles from Guelph, you enter the agricultural part of Southern Ontario. Nearby on Brewery Bay is the former summer home of the famous Canadian economist, author, and humorist, Stephen Leacock.

Enter at Sarnia — 135 Miles to Guelph

SARNIA will impress you with its docks, oil refineries, and chemical plants. In fact, a few miles southeast of the city at Oil Springs you will find a memorial to James Miller Williams who brought in the first commercial oil well on this continent in 1857. Five years later Ontario's first gusher flowed uncontrolled for a week but when tamed produced 2,000 barrels a day, and for a while required 160 teams of horses per day to move the oil over a plank road. Along Route 7 you will come to Stratford on the Avon River—the home of the Shakespearean Festival. You will require reservations several weeks in advance if you want to attend a Shakespearean play while in Ontario. The city of Kitchener was named after the great British general in a moment of patriotic fervour during World War I; it used to be called Berlin. The land around the city is farmed by some of the best Soil Conservationists we have—the Mennonites who emigrated from Pennsylvania.

Enter at Windsor — 200 Miles to Guelph

LIKE ITS big sister, Detroit, across the river, Windsor is known as the "Motor City." Less than 200 years ago, an Ottawa Indian Chief named Pontiac assembled his forces for the unsuccessful attack on Detroit, a community of one hundred homes surrounded by a palisade. The counties of Essex and Kent will remind you of Ohio, Indiana, or Illinois—corn, soybeans, hogs, cattle, and dark productive soils. If you stay on Route 401 you will by-pass London, the nerve center of Ontario's T.V.A. (Thames Valley Authority). The 26 River Valley Authorities in Ontario come under the jurisdiction of the Conservation Branch of the Department of Planning and Development. This Branch of the Ontario Government supervises the formation of a Conservation Authority, carries out the integrated surveys, and assists in financing the Authority's program. The city of Brantford was named in honor of Joseph Brant, a Mohawk Indian Chief, born in Ohio, educated in Connecticut, and the leader of the Six Nation Indians in support of the British Crown. He was buried at the Mohawk chapel near the city. Alexander Graham Bell perfected the telephone at Brantford; a memorial and museum are located on the Bell homestead.

Guelph, Ontario, is easy to reach by car, plane or train from any point in the United States. Many SCSA families are now planning a vacation in Canada along with attending the annual meeting.

Enter Along the Niagara—100 Miles to Guelph

FEW communities have the colorful historical background, the unparalleled beauty, the industrial development, and the varied agriculture that you will find along the Niagara frontier. No matter how many times you see Niagara Falls you still pause and wonder. Nearby is the Welland Canal that permits ocean steamers and lake freighters to "climb a hill"—Lake Ontario is 328 feet lower than Lake Erie. The Canal is part of the Seaway that enables ships to sail 2,220 miles inland from the Atlantic Ocean. The Queen Elizabeth Highway cuts through Ontario's fruit belt, important in the production of peaches, grapes, cherries, and other small fruits. The area is widely known for crops of market vegetables, and the wine and canning industries. For more details see the article: *Urban Impact In The Niagara Fruit Belt* in the March 1959 issue of the JOURNAL. Hamilton, with its huge land-locked harbour, is the Pittsburgh of Ontario. Outside the city you pass through the Royal Botanical Gardens with its multitudes of plants and formal designs.

The Royal City of Guelph

GUELPH, founded in 1827, was named in honor of the British Royal Family which bore the name Guelph before changing it to Windsor. The local Chamber of Commerce reminds us of a special law requiring every building on the main street to be fronted with the fine grey limestone that abounds in the area. The Royal City claims to be one of the Dominion's fastest growing cities with a population of 37,000, over 100 diversified industries, 3 colleges, and a provincial penal institution. Among the city's distinguished sons are John McCrae who wrote the immortal poem "In Flander's Fields" and Edward Johnson, the famed tenor, who became general manager of the New York Metropolitan Opera.

Three Colleges:

The Faculties of Agriculture, Veterinary Medicine, and Household Science are located on the one campus immediately south of the city of Guelph on Highway Six. The buildings, grounds, experimental plots, and farms cover an area of 1,300 acres. During the school term 1,200 students study here; each year the College accommodates and arranges programs for 40,000 visitors.

The Ontario Agricultural College, established in 1874, carries on resident instruction, research, and extension in agriculture. The courses are available to men and women. A two-year course in agriculture is ideally fitted to farmers' sons and daughters who expect to remain on the farm. Graduates of the four-year course, leading to the B.S.A. Degree, find employment in industry, teaching, government service, and farming.

The teaching of Household Science began in 1903 with the donation by Sir William Macdonald of two buildings —Macdonald Institute, a school for instructional purposes, and Macdonald Hall, a women's residence. Students may enroll in a one-year diploma course or a four-year course leading to the B.H.Sc. degree.

The Ontario Veterinary College was established in Guelph in 1922. The Doctors of Veterinary Medicine who have graduated from this famous institution are found the world over.—L. R. WEBBER, *Chairman, Annual Meeting Local-Arrangements Committee, Guelph, Ontario.*

SCSA Objectives and Goals for 1960

Long-time Objectives:

Organizations, to accomplish their purpose and provide leadership for their cause, need to outline objectives and set a course to reach their ultimate goal. The Soil Conservation Society of America has made remarkable progress through following such a procedure. Society leaders have outlined the following for 1960 and first call attention to the long-time objectives of SCSA:

> "The objectives of this Society shall be the development and advancement of the science and art of good land use and management and the promotion of conservation of soil, water and related renewable natural resources including, without limitations, trees, grass, fish, wildlife, and all other forms of beneficial plant and animal life and for these purposes to employ education of the people and other appropriate means to the end that mankind may have the use and enjoyment of these resources forever."

Continuing Activities:

The Soil Conservation Society of America carries on certain continuing activities designed to contribute to the accomplishment of the long-time objectives:

a. The JOURNAL OF SOIL AND WATER CONSERVATION provides an exchange of technical and organizational material for information of members.

b. The annual meeting provides inspiration, leadership, information, and enthusiasm for the science and art of good land use.

c. Chapter programs, including those of student chapters, provide members with opportunity for local participation and to "put their shoulder to the wheel."

d. Awards and recognition programs are designed to recognize leadership.

e. Committees are formed on various technical problems and to carry out specific projects.

f. Publications of a popular and technical nature to promote soil and water conservation are distributed.

g. Society leaders represent the organization and the membership with numerous other groups on a national and international basis.

Specific Goals for 1960:

In addition to recurring activities the following specific goals for 1960 have been set:

1. To activitate one or more of the scholarship programs of the Development Fund Board.
2. To increase membership to 11,500.
3. To publish and distribute 10,000 copies of the booklet *Careers in Conservation* developed by the Special Publications Committee for interested students and educators.
4. To publish a new popular-type booklet on the theme of a beautiful America.
5. To distribute 500,000 copies of Society publications.
6. To print and distribute an informational publication on snow surveys.
7. To finalize construction plans and to raise $20,000 of the $100,000 needed for the Society headquarters building.
8. To sponsor the Society's first annual meeting to be held in Canada.

1959—A WONDERFUL MEETING

Start at the top left and work down each column of photos on the next page. You can get an essence of the great annual meeting held last August in Rapid City, South Dakota.

The council met early for 3 days. Gary Bobst (hand on chin) describes his work as chairman of the program committee.

Registration of 2,000 proved arduous. Here Charles "Dave" Crocker from the Korean chapter registers. Below him is W. A. Rockie (substituting for Alaska) and J. H. Christ of Hawaii, and then Palmer Skalland and Lorne Nestrud of South Dakota flank Manuel Mateos of Avilia, Spain.

Refreshments and socializing broke the ice the first evening. A premier showing of the "America The Beautiful" exhibit is in the background.

The "commemorative stamp" program was most impressive. George King, special representative of the P. O. Dept., Harper Simms, and Postmaster George Lampert of Rapid City inspect some of stamps being handled by a crew of 40 girls. Franklin R. Bruns of the P. O. Dept. combined dignity and humor in presenting stamp albums to some 50 dignitaries. Senator Case, USDA Asst. Secretary Peterson, and "Chief" Bennett received albums. Pres. "Ike" Eisenhower was sent a special mammoth-size postal embellished with over 800 conferee signatures and "soil conservation" stamps.

Local and national press, radio and TV coverage was best ever for annual meetings.

Family spirit dominated the occasion and was aided by a game feed, barbecue, field trips, the Passion Play, and western entertainment.

Harry Woodward, tours chairman, really didn't have to expound to former Governor Joe Foss on the merits of pheasants.

Awards and honors characterized the banquet. Elmer Sauer receives a gavel made from Pres. Eisenhower's Christmas tree.

H. H. Bennett received two thrilling ovations and he responded well. For three days the speaker's rostrum was filled by political notables and many scientists and technicians.

Exhibits by chapters, industry, and business filled the halls and rooms and outdoor space of the high school. Ontario and Canada's delegates preview the 1960 meeting; and Salt Lake City hopes for 1963.

Dairy Queens and the milk bar proved popular. The "Green Gold" exhibit of South Dakota range and farm plants impressively and colorfully furnished background for the main auditorium stage.

In the center of things were host and hostess John and Mrs. Loucks. They were ideally representative of the several hundred South Dakotians who worked hard to put on this most notable meeting. There is Norm Berg, exclaiming after the banquet and final event, "It's been tremendous; we'll all sleep tonight." (Photos by "IKE" D. ADMIRE, Cartographic Div., SCS, Lincoln, Nebr.)

NATIONAL CONSERVATION CONFERENCE IN KOREA

ON November 11, 1959, approximately 5,000 Korean soil conservation, forestry management and upper watershed development technicians opened a three-day discussion and training conference at Pilot Project No. 3, near Seoul. The opening session of this second National Conservation Conference in Korea was addressed by Korean President Syngman Rhee. The President told the conference that the country's already sadly depleted soil resources must be conserved if the nation was to realize its need to prosper.

As part of the opening day ceremonies, the Korean Chapter of the Soil Conservation Society of America presented to President Rhee an engraved certificate and a Hugh Hammond Bennett SCSA medallion enrolling him as an honorary member of the Chapter. The presentation was made by Chapter Vice-President W. Bassett Orr, Agricultural Officer of the United States Operation Mission to Korea (USOM-K).

Pilot Project No. 3 is one of 38 presently active areas where USOM-K and the Republic of Korea (ROKG) land and water use technicians have established major demonstrations to show what can be done to convert Korea's wastelands to productive forest or crop areas. This project has been in operation for three years. One purpose of the three-day workshop was to show the progress which had been made to date. The pilot area was one in which erosion had progressed to a very advanced stage; where all natural cover had been removed to use as fuel; and where the little remaining soils had been leached of chemicals needed for plant food. In this area crop yields were so low that the villagers were not even producing sufficient food and fuel for their families.

It is estimated that over 35 per cent of the total land area of Korea is similar in condition with that which had existed in and near Project No. 3. The USOM-K/-ROKG cooperative program for upper watershed management has established other pilot areas where concentrated efforts toward conservation and management will be demonstrated as examples for other communities. Volunteer village organizations were formed to carry out these projects under the supervision of USOM-K and ROKG technicians. The U. S. Aid programs supplied seed, fertilizers and technical advice to assist.

In three years on these project areas a grass-legume cover has been established on previously bare hillsides and seedling pine and acacia trees have made a good growth. Acacia provides a fast-growing source of fuelwood. Korea's cold winters make it necessary for the villagers to have a reliable source of fuel. Some land formerly useless for crops is now cultivated and provides good yields. This restored cropland, farmed under close supervision according to recommended conservation practices, no longer contributes to erosion as was true when the project was started three years ago. Land-capability mapping has been completed and a land-use program has been developed based upon these maps.

The conferees, during their three-day session, had an opportunity to walk over the entire pilot-village area and to discuss with technicians and villagers the work which had been done. They also heard reports on the progress of work on pilot areas in other parts of the country.

One day of the conference was devoted to technical aspects of the land-use program, with thirty technical papers read and discussed. A transcript incorporating these papers and the discussions is now being prepared by the conference Secretariat.

President Rhee, in opening the conference, spoke for almost an hour on the need for improved conservation programs in Korea. He reviewed the former bad condition of most of Korea's upper watershed area; and praised the conservation work which has been done to date.

Charts, prepared and exhibited by the ROKG Bureau of Forestry, showed graphically the progress which had been made in recent years in conservation work. Panoramic pictures of several areas showing "before" and "present" conditions, gave visible proof of the program's effectiveness.

A majority of the USOM-K technicians who are associated with this project are members of the Korean Chapter of the Soil Conservation Society of America. Twelve out of the 16 active members of the Chapter participated in parts of the three-day conference as observers or resource persons.

CHAPTER NEWS

Virginia Chapter. As is true of other chapter newsletters, the Virginia newsletter was high in praise of the wonderful and excellent annual SCSA meeting in South Dakota. A report on the meeting was made before the Virginia chapter members at their annual meeting held at Natural Bridge November 6 and 7.

W. H. Mann received a check of $75 as a cash award (money was used to defray expenses to the annual SCSA meeting in South Dakota) for winning the SCSA booklets sales competition. He sold 13,000 copies of SCSA publications.

An advanced program of the annual meeting shows "industries' stake in conservation" having a large part in discussions. Several powerful speakers representing industry and commercial forestry participated.

Progress in "upper" watershed management during past three years is shown in the Korean conservation conference exhibits. These visual-aids were studied by the technicians and others.

President Syngman Rhee, Korea, addresses delegates to the 2nd National Convention Expediting the Upper Watershed and Forest Erosion Control Program jointly operated by USMO-K and ROKG technicians.

SOIL "CONVERSATION"

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CHAPTER NEWS

Minott Silliman, Jr. (left), SCSA councilman of the North Central Region, presents the 1959 SCSA Chapter Activities Sweepstakes Banner to John Stall (center), Northern Illinois Chapter chairman, 1958, and Reece Ayers, chairmann, 1959.

Wisconsin Chapter (Dale C. Aebischer, Chairman, 4324 Upland Dr., Madison 5). The Wisconsin Chapter has an outstanding activity aimed at stimulating Boy Scouts and Explorers "to advance the science and art of good land use." It encourages the scouts to take a greater interest in the soil and water conservation merit badge and helps educate the youth who have a natural interest in soil, water and other natural resources.

The chapter project has three distinct phases or activities which are as follows:

1. Furnish counselors in conservation—The Scout Councils were furnished directories listing some 1,100 persons who are potential merit badge counselors in conservation.

2. Furnish conservation information—1,900 packets containing six conservation bulletins were supplied to all troops in Wisconsin. **The Story of Land** and **Wonder of Water** were purchased by the chapter and included in the packet. The packet cover or container was supplied by interested chapter members and companies. The packets were assembled by a scout troop with the chapter furnishing refreshments. The packets were distributed to the council headquarters by chapter members in their regular travels throughout the state. The council headquarters distributed the material to troops. The end result was conservation material readily available to 35,000 Boy Scouts and Explorers.

3. Recognition of outstanding conservation achievement—The chapter is working out an awards program to recognize outstanding conservation work by individual scouts and by entire troops. The individual scout award will be a neckerchief slide. The awards program has achieved the sanction of the National Council of the Boy Scouts of America.

This activity was conceived in 1957, born in 1958 and had its greatest growth and development in 1959. The chapter expects to expand the activity and hopes other states will consider the activity with Boy Scouts and Explorers in their state. [NOTE: North Carolina also has a strong Boy Scout program.]

—SCSA—

Frank E. Indorf, Jr., and **Matthew A. Puchalski** were two of the soil scientists from the northeast taking the Genesis, Morphology, and Classification of Soils course with **Professor Marlin Cline** at Cornell University last spring. They suggest that here is a course that should be taken by all soils personnel.

NEWS OF MEMBERS

Dr. Frank Fraser Darling, noted British ecologist, has been associated with the Conservation Foundation since May, 1959, as vice president for research. Dr. Darling is well known throughout the world for his research studies in biology, agriculture, natural history, animal husbandry, wildlife and genetics. He had previously made several visits to the United States and produced, following one trip, an interesting book entitled, "Pelican in the Wilderness" (Random House, N. Y. 1956). From 1944 to 1950 he was director of the West Highland Survey, a study of the influence of land use and environmental change on Scottish Highland agricultural ways of life.

"Conservation," Dr. Darling says, "is closely bound up with the pressures between human communities and their environment, and between themselves. One of its values lies in elucidating causes and trends of environmental change and forecasting consequences."

Dr. Darling will guide the continuing research work of the Foundation, which currently includes studies of population pressures, crop yields, water usage, Alaskan development and the effects of chemical pesticides on the environment. He will also have opportunity to continue his own field studies of the causes and consequences of environmental change in the United States, Africa, and other parts of the world.

Since its founding in 1948, the Conservation Foundation has produced an imposing number of results (publications, films, film strips, educational research centers, and meetings and consultations) related to many aspects of conservation. The entire program of the Foundation can truly be said to be "most imaginative, productive and useful." Furthermore, the impact of its program is felt world-wide.

Joseph J. Shomon, an active member of the Virginia chapter, received his Ph.D. degree in natural resources conservation recently from the University of Michigan. His thesis, entitled, "Effective Conservation Communications," concludes that (1) failure to recognize vital conservation issues and failure to resolve them can lead America to disaster, and (2) public awareness in a democracy is the most important single factor in the resolution of our natural resources issues and problems. Shomon is chief of the Virginia Game Commission's education division and editor of *Virginia Wildlife* magazine.

Charles Simkins, extension soil specialist in Minnesota is on leave after spending two years in Iran. Apparently he is moving ahead rapidly on his work as he has already established in Iran about 20,000 demonstration plots.

Dr. William Martin, head of the Soils Department of the University of Minnesota, spent a month in Israel this summer. He was advising agricultural authorities of Israel on the possibility of improved use of commercial fertilizers and organic matter management on land where water for irrigation is limited.

Dr. Joseph H. Stoeckeler, senior soil scientist at the Lake States Forest Experiment Station left July 15 on a Senior Post-doctoral Fellowship of the National Science Foundation for a year's research in Europe.

H. G. Wilm, commissioner, Dept. of Conservation, N. Y.; **Herbert C. Storey,** chief, Watershed Management Research, USFS, Washington, D. C.; **L. L. Harrold,** project leader, Soil and Water Laboratory, ARS, Coshocton, Ohio; and **M. Matinelli,** Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colo., presented papers at the Symposium on Forests and Water and Lysimeters, Hanover-Munden, Germany, Sept. 8-11, 1959.

Dr. Joe B. Douthit of Pendleton, South Carolina, has retired from active farming and will move to Clemson, South Carolina. His farm has been purchased by Clemson College for use as part of a new field station and will have a rather complete soil and water conservation system laid out prior to any uses as an experiment station. "Doctor" Joe is an Honorary member of SCSA and has been active in District work and the NASCD.

Owen R. Boyd, manager of the Wethersfield Farm at Amenia, New York, and a member of SCSA, had an article on "The Importance of Soil Conservation on the Farm" in the May 1959 *Guernsey Breeders' Journal.* From an examination of the article, it is very evident that here is a farm which is practicing over a broad front many kinds of soil, water, forest, and wildlife and recreation conservation. It is an excellent article and well illustrated.

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Dr. Stephen S. Visher of Bloomington, Indiana, and a charter member of SCSA, recently received the "Outstanding Achievement Award" of the Association of American Geographers. This award has been made only 6 times in 55 years. The citation was for his long geographic teaching, and especially for his extensive research in Indiana climate and his pioneer work in social geography. Dr. Visher is active in the Indiana chapter and is emeritus professor of Geography at Indiana University.

Dr. Mary M. Keeffe, a member of the Southern New England chapter, recently attended the International Congress on Antibiotics in Perugia, Italy, the World Health Organization Congress in Geneva, Switzerland. This past summer at Dr. Keeffe's suggestion, science courses consisting of soil conservation, geology, entomology, and astronomy were introduced to fifth grade children for the first time at Beach Pond Camp in Rhode Island.

Grant F. Walton is now the New Jersey State Soil Conservation Committee's executive director. Walton had previously been associated with the Stony Brook Watershed in New Jersey.

Reginald M. DeNio, who has been the Assistant Regional Forester in California since 1954, has been named Director of the Division of Range Management in the USDA's Forest Service. He will be located in Washington, D. C., effective January 1960.

Early this summer **"T-Bone" McDonald,** active in the SCSA in Oklahoma, held a number of news-writing clinics. He was assisted by **Tarleton Jenkins** of Denver, Colorado, and a number of area conservationists.

N. O. Stephenson, Erosion Control Agent with the State Soil Conservation Committee of Wisconsin, received the Distinguished Service Award from the National Association of County Agents in Kansas City, Missouri, in September 1959.

At the 16th annual convention of the Arizona Association of Soil Conservation Districts, held November 11, 1959, there were 3 Fellows and 7 members of the Soil Conservation Society of America on the program. The Fellows included **Thomas L. Ayers, Dr. W. R. Tascher** and **Evan L. Flory.** The members included **Dr. Richard Frevert, Dr. Chester E. Evans, Dr. Harold E. Myers, Dr. B. Ira Judd, Robert V. Boyle, Dan LeCrone** and **Everett Mercer.** The theme of the meeting was "Exploring areas where better coordinated and cooperative soil and water conservation efforts can be obtained."

Joe O'Hara, chairman of the Page District in Iowa, is the new vice-chairman of the Iowa State Soil Conservation District Association.

A new member of the Southern New England SCSA chapter is **Robert G. Cooke** of Rehoboth, Mass. He is with the Industrial National Bank of Providence and is responsible for all agricultural loans.

Dr. Harlan Brumsted of Cornell University has been conducting fish pond meetings throughout the state of New York.

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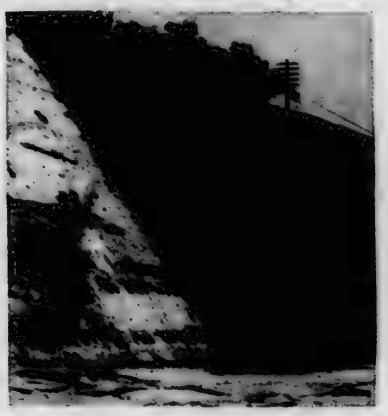

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1. Magnesium deficiencies usually show up in the leaves of the plant before serious damage has been done to the yield.
   True **False**
2. Magnesium deficiencies are most apparent in.....
   .....
   a. Root Structures **b. Leaves** **c. Stems**
3. Seed development often requires more magnesium than .....
   a. Nitrogen **b. Phosphorus** **c. Potassium**
4. Soil bacteria growth is stimulated by magnesium.
   True **False**
5. Magnesium availability in the soil is not affected by the amount of available calcium.
   True **False**
6. An application of magnesium limestone will not change the pH of the soil.
   True **False**
7. Yields are cut as a result of magnesium deficiencies because magnesium is a major element in seeds and fruit, and because magnesium acts as a carrier for another important element. That element is.....
   a. Phosphorus **b. Potassium** **c. Calcium**
8. Addition of high-analysis fertilizers containing sulfates, chlorides and nitrates helps to slow the loss of magnesium.
   True **False**
9. The greatest amount of magnesium is removed from the soil by leaching.
   True **False**
10. Water-soluble sulphate of potash-magnesia (Sul-Po-Mag) does not change the soil pH.
    True **False**

FOR THE CORRECT ANSWERS turn this ad upside down. If you answered 8 out of 10 questions correctly, chances are you are pretty well informed on the role magnesium plays in crop quantity and quality. If you had difficulty, you may be interested in sending for our booklet, "Magnesium."

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James E. Cammack of LaSalle Parish, Louisiana, was surprised on August 21 by a group of 75 neighbors, friends, and coworkers who met to pay tribute to him. Cammack recently retired from active work in the Soil Conservation Service.

NECROLOGY

Professor Alfred J. Wojta died July 21, 1959. For the past fifteen years he was associated with the University of Wisconsin where he had obtained advanced degrees in Agricultural Engineering. Prior to his service with the University he worked with the Soil Conservation Service. He has been a member of the SCSA since 1951 and was active in the affairs of the Wisconsin Chapter.

In Wisconsin Al Wojta had become well known for the development of a simple, effective land-forming system for the economical removal of excess surface water from both upland and low-lying fields. This program has been hailed as one of the greatest contributions to improved agriculture on periodically wet cultivated soils.

While Al Wojta's responsibilities were primarily in the field of agricultural advancement, he had a deep appreciation of the importance of wetlands for wildlife. In the past few years he voluntarily served on a committee which was studying wetland classification and development for agriculture and wildlife.

D. W. Orcutt of Lexington, Kentucky, died in May, 1959, as the result of accidental gunshot wounds.

Frank Walker of Cameron, West Virginia, died late this summer. He was active in the West Virginia Chapter.

Gerald L. (Jerry) Seaman, 47, radio-television director of Bert S. Gittins Advertising, Inc., Milwaukee, Wis., died Sunday, November 8, at Columbia Hospital in Milwaukee after becoming ill at his home. He suffered a heart condition since 1955.

Mr. Seaman had been with Bert S. Gittins since October, 1945, and during those 14 years he handled for that agency the National Farm and Home Hour, sponsored by Allis-Chalmers on the NBC radio network.

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Truly modern from end to end, from the ground up. Hydraulic, finger-tip controls; wide, uncluttered platform. Seat is offset for greater visibility. Oliver-matched equipment includes bulldozer, angledozer, scarifier and winch.

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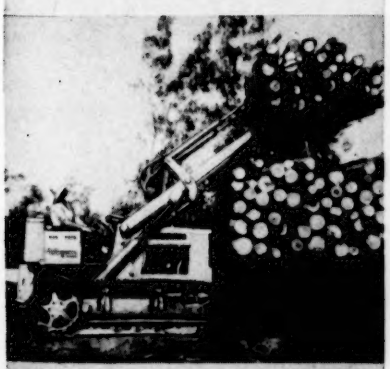

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